ADOPT #20211053

Reduction of Cadmium Uptake in Flax Using Agronomic Strategies

Final report combining data from all sites in 2022

-

Report prepared by

Wayne Thompson[1], Kaeley Kindrachuk[2], Ishita Patel[3], Lana Shaw[3], Mike Hall[4], Jessica Enns[5], and Chris Holzapfel[6]

[1]Western Grains Research Foundation
[2]Saskatchewan Canola Development Commission
[3]South East Research Farm, Redvers SK
[4]East Central Research Foundation, Yorkton SK
[5]Western Applied Research Corporation, Scott SK
[6]Indian Head Agricultural Research Foundation, Indian Head SK

Project Identification

1. **Project Title:** Reduction of Cadmium Uptake in Flax Using Agronomic Strategies
2. **Project Number:** ADOPT 20211053
3. **Producer Group Sponsoring the Project:** SaskFlax
4. **Project Location(s):**
    - SERF (Redvers)
    - IHARF (Indian Head)
    - WARC (Scott)
    - ECRF (Yorkton)
5. **Project start and end dates (month & year):** April 2022 to January 2023
6. **Project contact person & contact details:**

Kaeley Kindrachuk - kkindrachuk@saskcanola.com

Objectives and Rationale

7. **Project objectives:**

This project was set up at four sites across Saskatchewan to demonstrate the efficacy of zinc and calcium fertilization for reducing cadmium levels in flaxseed. Varying rates of zinc sulphate and gypsum were applied and evaluated for their effect on cadmium accumulation in harvested flaxseed. Toxicity effect on plants during the growing season was also assessed. Lastly, an economic analysis was done to compare the economic feasibility of products.

8. **Project Rationale:**

Cadmium is a toxic, non-essential heavy metal which is found naturally in Saskatchewan soils (1). Flax can accumulate high levels of cadmium in seeds, thereby introducing cadmium into the food chain (2). Cadmium accumulation has been an emerging trade concern for Canadian flax farmers after the European Union in 2021 established new regulations on maximum allowable levels of cadmium in linseed of 0.5 mg/kg or 0.5 parts per million (Official document, 3).

There is ongoing research at Agriculture and Agri-Food Canada and the University of Saskatchewan to breed for low cadmium-accumulating flax varieties (4); however, with the recent new regulations on flax imports in emerging markets, it is important to look for interim solutions and assess their economic viability. Using zinc and calcium has shown potential in pot studies in reducing cadmium accumulation in plants. Fertilizing with zinc reduced cadmium accumulation in flaxseed by 20% (5), and other studies involving durum wheat show similar effects (6, 7). Calcium/gypsum ($CaSO_4$) application also reportedly reduced cadmium accumulation and content in lentil, faba bean, wheat, and canola (8, 9), likely due to the physiochemical similarities between calcium and cadmium ions. Using zinc sulphate and gypsum could thus prove to be viable and economically feasible interim solutions in addressing the pressing issue of cadmium accumulation in flax.

(1) G. S. R. Krishnamurti, P. M. Huang, L. M. Kozak, H. P. W. Rostad, K. C. J. Van Rees, Distribution of cadmium in selected soil profiles of Saskatchewan, Canada: Speciation and availability. Can. J. Soil Sci. 77, 613–619 (1997).
(2) C. A. Grant, W. T. Buckley, L. D. Bailey, F. Selles, Cadmium accumulation in crops. Can. J. Plant Sci. 78, 1–17 (1998).
(3) EU regulation amendement market news (August, 2021). https://www.merieuxnutrisciences.com/eu/all-news/news-maximum-levels-cadmium-and-lead-amendedeu#:~:text=Therefore%2C%20it%20is%20appropriate%20to,and%20cadmium%20in%20certain%20foodstuffs.
(4) Diverse Field Crop Cluster, SaskFlax. https://www.dfcc.ca/flax-a5
(5) Y. Jiao, C. A. Grant, L. D. Bailey, Effects of phosphorus and zinc fertilizer on cadmium uptake and distribution in flax and durum wheat. *J. Sci. Food Agric.* **84**, 777–785 (2004).
(6) J. J. Hart, R. M. Welch, W. A. Norvell, J. M. Clarke, L. V Kochian, Zinc effects on cadmium accumulation and partitioning in near-isogenic lines of durum wheat that differ in grain cadmium concentration. *New Phytol.* **167**, 391–401 (2005).
(7) N. Köleli, S. Eker, I. Cakmak, Effect of zinc fertilization on cadmium toxicity in durum and bread wheat

grown in zinc-deficient soil. *Environ. Pollut.* **131**, 453–459 (2004).
(8) D. Huang, X. Gong, Y. Liu, G. Zeng, C. Lai, H. Bashir, L. Zhou, D. Wang, P. Xu, M. Cheng, J. Wan, Effects of calcium at toxic concentrations of cadmium in plants. *Planta*. **245**, 863–873 (2017).
(9) M. S. Abbas, M. Akmal, S. Ullah, M. U. Hassan, S. Farooq, Effectiveness of Zinc and Gypsum Application Against Cadmium Toxicity and Accumulation in Wheat (*Triticum aestivum* L.). *Commun. Soil Sci. Plant Anal.* **48**, 1659–1668 (2017).

Methodology and Results

9. Methodology:

The project was carried out at four sites – WARC (Scott), ECRF (Yorkton), IHARF (Indian Head), and SERF (Redvers) in 2022. Prior to seeding, soil tests were conducted at each site to determine the level of cadmium in the soil. Additionally, since commercial phosphate fertilizers naturally contain cadmium and can be a major source of cadmium addition to the soil, a sample of the fertilizer MAP (Monoammonium phosphate) used at each site was sent to the lab for cadmium testing. The flax variety used for this project was Prairie Thunder, a high cadmium-accumulating variety. The seed had 87% germination rate, 81% vigour index, and the TKW was 4.840 g and the seeding rate varied slightly across sites but was approximately 50 kg/ha. The field trials were set up as randomized complete block design with four replicates and seven treatments. The treatments were: 1) Untreated control, 2) Zn at 1X rate, 3) Zn at 0.5X (low) rate, 4) Zn at 2X (high) rate, 5) Gypsum at 1X rate, 6) Gypsum at 0.5X (low) rate, and 7) Gypsum at 2X (high) rate. The Zn product used was Zinc Sulphate Granular from Nexus BioAg, and the gypsum product used was GypRich Prill from Diverge Business Development Inc. Table 1 shows the treatments and rates of applied products. To ensure that other nutrients were not limiting, N, P, and S fertilizers were applied across all treatments at a constant rate of approximately 90 kg/ha, 30 kg/ha, and 20 kg/ha respectively. All fertilizers, including the treatments, were side banded at seeding.

During the growing season, data were collected on establishment density and plant height post flowering to determine any adverse effects of the treatments on plant growth. Pest management varied across locations; however, weeds, disease, and insects were intended to be non-limiting in all cases. After harvest, yield was calculated (adjusted for dockage and to a uniform seed moisture content of 10%), and the harvested flaxseed samples were sent to the lab for quantification of accumulated cadmium. Table A1 in the Appendix provides temperature and precipitation data for the 2022 growing season, and Table A2 has the dates for operations at each site.

Table 1. Treatments and rates used for the project.

Trt #	Trt Description	Rate of Trt	Rate of product applied*
1	Untreated control - no zinc, no gypsum	-	-
2	Zn - 1X rate	2.5 kg/ha Zn	7.04 kg/ha $ZnSO_4$ product
3	Zn - low rate (0.5X rate)	1.25 kg/ha Zn	3.52 kg/ha $ZnSO_4$ product
4	Zn - high rate (2X rate)	5 kg/ha Zn	14.08 kg/ha $ZnSO_4$ product
5	Gypsum - 1x rate	107 kg/ha gypsum	133.75 kg/ha gypsum product
6	Gypsum - low rate (0.5X rate)	53.5 kg/ha gypsum	66.88 kg/ha gypsum product
7	Gypsum - high rate (2X rate)	214 kg/ha gypsum	267.5 kg/ha gypsum product

*Amount of product was calculated based on information from the product suppliers that the zinc sulphate product contained 35.5% zinc and the gypsum product contained 80% gypsum. The gypsum product contained 20% calcium.

Data were analysed for Treatment and Site effects using R statistical software (R Core Team, 2019). These data were analyzed in a one-way ANOVA after fitting a linear model with Treatment as the fixed factor and Replicate as the random factor. Data within each site were compared between treatments using Statistix 10.0 and treatment differences were considered significant at $P \leq 0.10$.

10. Results

Soil and MAP fertilizer tests revealed a huge variation in Cadmium levels between sites (Table 2). Cadmium levels in soil ranged from negligible (<0.1 ppm) at SERF to 0.5 ppm at ECRF. Cadmium levels in the MAP fertilizer ranged from 26.2 ppm at WARC to 43.4 ppm at ECRF. Depending on the rate of application of MAP at each site, the amount of cadmium applied ranged from 0.003 lb/ac at WARC and ECRF to 0.006 lb/ac at IHARF. Full soil and fertilizer analysis reports are included in Appendix tables A3 and A4, and the fertility information for each site is included in appendix table A5.

Table 2. Lab analysis of Cadmium content in MAP fertilizer and soil at different sites and their soil types.

Site	**WARC (Scott)**	**ECRF (Yorkton)**	**IHARF (Indian Head)**	**SERF (Redvers)**
Soil type	Dark brown, loam	Moist black, clay loam	Black, clay	Black, loam
Cd in MAP fertilizer (ppm)†	26.2	43.3	41.3	29.7
Cd applied to soil*	0.003 lb/ac (0.006% of applied MAP)	0.003 lb/ac (0.004% of applied MAP)	0.006 lb/ac (0.01% of applied MAP)	0.004 lb/ac (0.007% of applied MAP)
Cd in soil (ppm) †	0.3	0.5	0.2	<0.1

†Analysis from Agvise Laboratories Inc, North Dakota, USA.
*Calculated based on lab results for cadmium (ppm) in MAP and the rate of MAP application at each site.

Mean values of parameters for each treatment along with site averages and p-values from ANOVA are shown in Table 3.

Table 3. Means of parameters and results after ANOVA analysis for each site. Different letters beside values, where present, indicate statistically significant differences in means for that column at 90% confidence level for that site. Absence of letters indicate no statistically significant difference between means for that site.

Site		**Treatment**	**Plant density (plants/m²)**	**Plant height (cm)**	**Seed Cd (ppm)**	**Yield (kg/ha)**
WARC	1	Untreated control	246	51	0.56	2176
	2	Zn - 1X rate	223	51	0.57	2207
	3	Zn - low rate (0.5X rate)	229	51	0.58	2241
	4	Zn - high rate (2X rate)	233	52	0.51	2186
	5	Gypsum - 1x rate	242	52	0.57	2234
	6	Gypsum - low rate (0.5X rate)	236	53	0.57	2238
	7	Gypsum - high rate (2X rate)	232	52	0.59	2146
		Site average	234	52	0.56	2204
		p-value	0.98	0.71	0.74	0.69
ECRF	1	Untreated control	593	65	0.51[ab]	2841
	2	Zn - 1X rate	603	67	0.61[a]	3262
	3	Zn - low rate (0.5X rate)	591	68	0.49[ab]	3023
	4	Zn - high rate (2X rate)	636	69	0.41[b]	3075
	5	Gypsum - 1x rate	598	67	0.47[ab]	3013
	6	Gypsum - low rate (0.5X rate)	547	68	0.52[ab]	2887
	7	Gypsum - high rate (2X rate)	515	68	0.62[a]	3272
		Site average	583	67	0.52	3053
		p-value	0.15	0.16	0.07	0.14
IHARF	1	Untreated control	485	52	0.60	3083
	2	Zn - 1X rate	580	51	0.65	3160
	3	Zn - low rate (0.5X rate)	477	52	0.68	3137
	4	Zn - high rate (2X rate)	502	53	0.62	3096
	5	Gypsum - 1x rate	549	53	0.66	3079
	6	Gypsum - low rate (0.5X rate)	552	50	0.61	3097
	7	Gypsum - high rate (2X rate)	537	52	0.65	3135
		Site average	526	52	0.64	3112
		p-value	0.24	0.20	0.90	0.66
SERF	1	Untreated control	940	55	0.18	2423
	2	Zn - 1X rate	969	55	0.22	2574
	3	Zn - low rate (0.5X rate)	951	57	0.23	2458
	4	Zn - high rate (2X rate)	914	56	0.24	2474

5	Gypsum - 1x rate	935	55	0.18	2427
6	Gypsum - low rate (0.5X rate)	938	56	0.23	2560
7	Gypsum - high rate (2X rate)	935	54	0.17	2489
	Site average	940	55	0.20	2486
	p-value	0.97	0.43	0.63	0.38

Overall ANOVA after combining data from all sites showed that only the effect of Site was statistically significant with p-value <0.0001 for all parameters. The overall effects of treatment and the interaction between treatment and site were not significant. Plant density was significantly higher at SERF and ECRF compared to IHARF and WARC, which was likely a direct result of higher seeding rates at those sites. Plant heights were highest at IHARF and lowest at WARC. Yield at IHARF across all treatments was higher than other sites but was not significantly different from ECRF. Yield at ECRF was likely affected by hail damage that occurred on June 23rd, 2022. Yield was lowest at WARC, which also had the lowest seeding rate, plant density, and height. Interestingly, IHARF had the highest seed cadmium values for all treatments, despite not having the highest soil and fertilizer cadmium levels (Values for cadmium at IHARF were 0.2 ppm and 41.3 ppm in soil and MAP, respectively). Along the same vein, SERF had the lowest seed cadmium values for all treatments even though its MAP cadmium level of 29.7 ppm was not the lowest. However, SERF had the lowest soil cadmium level out of all sites tested. This could be due to differences in soil type and texture – Indian Head has clay soil and SERF has loam soil.

Separate analysis for each site revealed that none of the treatments caused significant adverse effects on plant establishment and height, with p-values for all sites being >0.10 for plant density and height (Table 3). Similarly, yield did not significantly differ between treatments at any of the sites. Thus, none of the treatments led to toxicity effects in plants or significant effect on yield during the growing season.

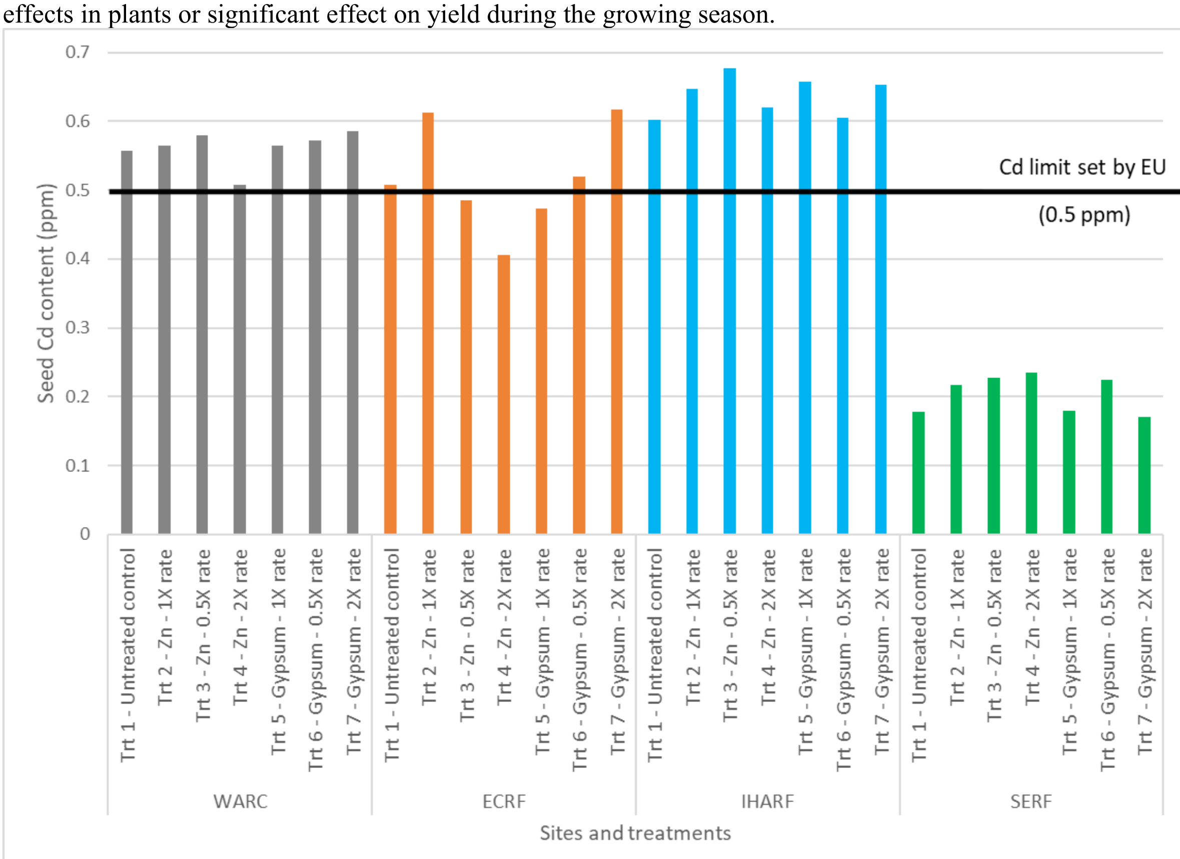

Figure 1. Cadmium accumulation in harvested flaxseed for various treatments at four different sites in the trial. Thick black line indicates maximum limit for cadmium in linseed set by the European Union (0.5 ppm).

Analysis of cadmium accumulation in harvested flaxseed showed differences between treatments within and between sites, as shown in Figure 1. The maximum cadmium limit set by the EU for flax is 0.5 ppm, and SERF (Redvers) was the only site that had cadmium seed content below this limit for all treatments. For WARC (Scott) and IHARF (Indian Head), none of the treatments produced cadmium levels below 0.5 ppm. Treatment differences within each site were only statistically significant for ECRF (Yorkton) with a p-value <0.1, where zinc applied at 2X rate was significantly more effective at reducing cadmium accumulation in flaxseed than zinc applied at 1X rate and gypsum applied at 2X rate. Importantly, although treatment differences at the ECRF site existed, none of the zinc sulphate or gypsum applications resulted in significantly lower Cd accumulation than the control.

Economic analysis

The suppliers for zinc and gypsum products used in this project quoted the cost of the zinc product to be $5.02/kg and the cost of the gypsum product to be $0.35/kg. The price of flax was assumed to be $18.50/bu (2023 Saskatchewan Crop Planning Guide), or $0.73/kg assuming a flax bushel weight of 56 lb/bu. Yield revenue was calculated for each site by multiplying the price of flax with average yield at that site.

Since yield was not statistically different between treatments at any of the sites, there was not a significant change in revenue from yield. However, the additional cost of zinc and gypsum applications would affect net returns. Table 4 shows the cost of each treatment application as a percent of yield revenue for all sites. Treatment costs ranged from 1% of yield revenue to as high as 6% of yield revenue, which was observed when gypsum applied at 2X rate at WARC. Since the application of zinc or gypsum did not lead to significant reduction in seed cadmium levels compared to the untreated control at any of the sites, investing in these treatments does not seem economically beneficial based on the data.

Table 4. Cost of treatment application as a % of yield revenue at each site.

Treatment		Treatment cost† ($/ha)	Treatment cost as % of yield revenue			
			WARC	ECRF	IHARF	SERF
1	Untreated control	0	0	0	0	0
2	Zn - 1X rate	35	2	2	2	2
3	Zn - low rate (0.5X rate)	18	1	1	1	1
4	Zn - high rate (2X rate)	71	4	3*	3	4
5	Gypsum - 1x rate	47	3	2	2	3
6	Gypsum - low rate (0.5X rate)	24	1	1	1	1
7	Gypsum - high rate (2X rate)	94	6	4	4	5

†Calculated based on the rate of products applied. Refer to Table 1 for more information.
*At ECRF, Treatment 4 (Zinc applied at 2X rate) led to a significant reduction in seed cadmium content compared to Treatments 2 and 7. None of the treatments were significant when compared to the control.

Extension

This project was highlighted on field days of all the four sites. Ishita Patel will present the findings from this project at the AgriARM Research Update webinar organized by the SK Ministry of Agriculture on March 1st, 2023.

11. Conclusions and Recommendations

Soil and MAP fertilizer samples analysed for cadmium content confirmed that cadmium levels vary drastically across Saskatchewan soils and in different samples of MAP. These differences in cadmium levels in soil and MAP fertilizer were reflected in how cadmium accumulated in harvested flaxseed at different sites, several of which had flax Cd levels higher than the MRL of 0.5 ppm set by the EU.

Treatment of flax with varying rates of zinc and gypsum showed no statistically significant difference on plant establishment and plant height between treatments at any site. Treatment effect on yield was also not statistically significant. Thus, none of the treatments in this trial led to toxicity effects in plants or significant reduction in yield during the growing season.

The effect of treatments on cadmium content in harvested flaxseed was mixed and statistically insignificant at all sites except ECRF. ECRF had some indication of treatment responses, and three treatments − zinc applied at 0.5X and 2X rate, and gypsum applied at 1X rate – had cadmium levels under the MRL of 0.5 ppm set by the EU. None of the treatments, however, had Cd levels that were significantly lower than the control at this site. SERF was the only site that had cadmium levels below 0.5 ppm for all treatments. None of the treatments at any site were effective at significantly reducing seed cadmium content compared to untreated control, thus making the treatments less economically worthwhile.

Supporting Information

12. Acknowledgements

Signage was put beside the trial for SaskFlax, and Ministry of Agriculture and ADOPT were acknowledged when giving an overview of the trial at field days at each location.

Prairie Thunder seed was arranged by SaskFlax. Zinc and gypsum products were donated by Nexus BioAg and DBD Inc, respectively.

13. Appendices

Table A1. Mean long-term and 2022 temperature and precipitation over the growing season at the 4 sites.

Location	Year	May	June	July	August	Avg. / Total
		---------------------*Mean Temperature (°C)* -------------------				
Indian Head	2022	10.9	16.1	18.1	18.3	15.8
	Long-term	***10.8***	***15.8***	***18.2***	***17.4***	***15.6***
Scott	2022	10.0	15.0	18.3	18.9	15.6
	Long-term	***10.8***	***14.8***	***17.3***	***16.3***	***14.8***
Redvers	2022	10.2	16.3	19.2	18.9	16.2
	Long-term	***11.1***	***16.2***	***18.7***	***18.0***	***16.0***
Yorkton	2022	10.6	15.7	18.6	18.9	16
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***15.2***
		--------------------------- *Precipitation (mm)* -------------------				
Indian Head	2022	97.7	27.5	114.5	45.9	285.6
	Long-term	***51.7***	***77.4***	***63.8***	***51.2***	***241.4***
Scott	2022	11	57.1	86.5	32.1	186.7
	Long-term	***38.9***	***69.7***	***69.4***	***48.7***	***226.7***
Redvers	2022	121	75	259	25.2	480.2
	Long-term	***60.0***	***85.2***	***65.5***	***46.6***	***272***
Yorkton	2022	137.9	57.9	38.4	90.8	325
	Long-term	***51***	***80***	***78***	***62***	***272***

Table A2. Dates of key operations at all sites.

Activity	**---------------------Date---------------------**			
	Indian Head	**Scott**	**Redvers**	**Yorkton**
Pre-seed/pre-emergent Herbicide Application	Roundup Weathermax @ 0.67 L/ac on May 22 & Authority 480 @ 118 ml/ac on May 27	Glyphosate 540 @ 1L/ac & AIM @35 ml/ac on May 16	Roundup @ 0.7 L/ac on May 27	None
Seeding	26-May	23-May	24-May	26-May
Emergence Counts	8-Jun	17-Jun	9-Jun	8-Jun
In-crop Herbicide Application	Centurion @ 150 ml/ac on June 20 & Curtail M @ 0.81 L/ac on June 24	Buctril M @ 0.4 L/ac, Centurion @ 150 ml/ac & Amigo @ 0.5L/100L (225mL/ac) on Jun 21	Buctril M @ 0.4 L/ac, Centurion @ 75 ml/ac & Amigo @ 0.2 L/ac on Jun 22	Curtail M on June 16 & Centurion on June 20
In-crop	None	None	None	None

Insecticide				
Fungicide	Dyax @ 0.16 L/ac (plus 0.125% Agrol 90) on July 17	Dyax @160ml/ac on Jul 14	None	Dyax @160ml/ac on Jul 15
Plant height measurements	4-Aug	28-Jul	10-Aug	4-Aug
Desiccation	12-Sep	11-Sep	26-Aug	16-Sep
Harvest	1-Oct	28-Sep	1-Sep	28-Sep

Table A3. Soil test results from all sites.

Property/ Element	Unit	IHARF		WARC		SERF		ECRF	
Depth	**cm**	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
CEC	**meq**	53.6	.	14.6	.	30	.	22.2	.
O.M.	**%**	4.2	.	4.1	.	4.2	.	7	.
Carbonates	**%**	6.3	.	0.4	.	2.3	.	0.4	.
ph		8.3	8	5.5	.	7.8	.	6.7	.
NO3-N	**ppm**	2.5	4.5	10	6	6	7.5	14	15
Olsen-P	**ppm**	2	.	7		9	.	22	
Sol Salts	**mmhos/cm**	0.54	0.51	0.17	0.21	0.28	0.4	0.33	0.4
Sulphur	**ppm**	7	9	7	7	12	29	13	11
Zn	**ppm**	0.27	.	1.25	.	0.79	.	2.33	.
Fe	**ppm**	9.6	.	114.4	.	15.1	.	48.5	.
Cu	**ppm**	2.3	.	0.69	.	0.62	.	0.76	.
Mn	**ppm**	4	.	18.6	.	2.5	.	10	.
Chloride	**ppm**	3.5	2.5	3.5	2	1.5	5	16	18.5
B	**ppm**	1.6	.	0.41	.	0.91	.	0.96	.
Cd-Total	**ppm**	0.2	.	0.3	.	<0.1	.	0.5	.
K	**ppm**	497	.	243	.	316	.	460	.
Ca	**ppm**	7436	.	1482	.	4857	.	3237	.
Mg	**ppm**	1799	.	242	.	575	.	570	.
Na	**ppm**	43	.	44	.	20	.	20	.

Table A4. Fertilizer analysis report from all sites. All values are after analysing the dried sample.

Parameter	Units	IHARF	WARC	SERF	ECRF
Total Phosphate (P2O5)	%	49.89	52.96	51.06	52.18
Cadmium	ppm	41.3	26.2	29.7	43.3
Total Nitrogen	%	12	12	12	12

Table A5. Flax seeding rate and applied fertilizers and their rates at seeding for all sites.

	Seeding/Application rate (lb/ac)			
	WARC	ECRF	IHARF	SERF
Flax – Prairie Thunder	45	49	49	55
Urea	128	108	160	128

MAP	52	59	58	51
AMS	74	42	74	74

Abstract

14. Abstract/Summary

Cadmium (Cd) is a toxic, heavy metal naturally found in Saskatchewan soils. Cd accumulation in flax is a major issue deemed to affect flax markets after the European Union in 2021 imposed a new maximum Cd limit of 0.5 parts per million (ppm) for imported linseed. This project evaluated the efficacy of zinc and gypsum application at seeding in reducing Cd accumulation in harvested flaxseed. A high Cd-accumulating variety, Prairie Thunder, was used. The experiment was set up as randomized complete block design at four sites – Indian Head, Yorkton, Scott, and Redvers. Untreated control was compared with treatments of zinc and gypsum each at 1X, 0.5X, and 2X rate. Soil and MAP fertilizer samples were collected prior to seeding to establish a baseline level of Cd at each site. During the growing season, data were collected on plant emergence and height to evaluate toxicity effects of treatments, and harvested seed was weighed and analysed for seed Cd content. Soil and MAP Cd levels varied considerably between sites, and the amount of Cd inadvertently added with MAP application varied from 0.003 lb/ac at Yorkton and Scott to 0.006 lb/ac at Indian Head. Soil Cd levels varied from negligible (<0.1 ppm) at Redvers to 0.5 ppm at Yorkton. In evaluation of plant traits, none of the treatments were found to have toxicity effects on flax as emergence, height, and yield did not vary significantly between treatments at any of the sites. In comparing the effects of treatments on Cd accumulation in harvested flaxseed, Redvers was the only site that had seed Cd levels for all treatments under the MRL of 0.5 ppm. Significant differences between treatments were only observed at Yorkton, where zinc applied at 2X rate resulted in a significantly reduced seed Cd content compared to zinc applied at 1X rate and gypsum applied at 2X rate. None of the other treatments generated statistically significant results, and none of the treatments at any site led to a significant reduction in seed Cd level compared to untreated control, even at ECRF where treatment effects were detected for this variable. So far, the efficacy of these treatments was questionable and there is need to test in another field season.

The trial was highlighted on field days of all four sites, and the results from this trial will be presented at the AgriARM Research Update in March 2023.