

**The Micronutrient and Trace
Element Status of Forty-Three
Soil Quality Benchmark Sites in
Alberta**

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ABSTRACT

Soil samples from the Alberta Environmentally Sustainable Agriculture (AESAs) Soil Quality Resource Monitoring Program Benchmark Sites were analyzed for 30 micronutrients and trace elements. The broad scan of micronutrient and trace elements provides useful baseline information regarding the variability and range of element concentrations within ecoregions, soil types and landscapes. This report describes the influence of ecoregions, soil properties and historic management practices on boron (B), chloride (Cl), cobalt (Co), molybdenum (Mo), nickel (Ni), silicon (Si), chromium (Cr), cadmium (Cd) and selenium (Se). Significant differences between ecoregions were found in the 0-15 cm soil samples for the elements B, Cd, and Mo, as well as for Cd in the 15-30 cm depth. Slope position had a significant effect on B, Ni, Co, Si, Cd and Se; and in most instances the highest values occurred in the lower slope position. Significant ($p > 0.05$) differences between other elements and selected soil properties were found for B, Mo, Ni, Co, Cd and Se. Management did not appear to have an impact on the micronutrients and trace elements, although management practices that influence soil organic matter could influence some elements. No evidence of toxic levels of B, Mo, Cr or Cd was noted at any of the benchmark locations, although Ni may have the potential of causing phytotoxicity at one site. Many of the sites may be deficient in Cl for crop production and low Se may be an issue for livestock production at some of the locations. Further investigation, including plant tissue analysis is recommended at some sites for the elements Ni, Si, Cr, Cd and Se. The literature does not provide well-defined criteria for determining deficiency or toxicity for many trace elements. While there was limited information for some of the elements, the extraction methods utilized were different from the methods used in this study, making comparisons difficult. Sampling the upper, mid and lower slope positions at each of the sites provided valuable information on the distribution of the elements within the landscape. Micronutrient and trace element analysis of some crop samples would provide useful supplemental information for interpreting the soil data.

1.0 INTRODUCTION

This report describes the micronutrient and trace element status of the AESA (Alberta Environmentally Sustainable Agriculture) Soil Quality Benchmark Sites. Previous reports completed for this study include:

1. *Baseline soil physical and chemical properties of forty-three soil quality benchmark sites in Alberta.*
2. *Preliminary statistical analysis of baseline soil organic carbon and nitrogen data of forty-three soil quality benchmark sites in Alberta.*
3. *Preliminary statistical analysis of baseline soil fertility data of forty-three soil quality benchmark sites in Alberta.*
4. *Micronutrient (Cu, Fe, Mn, and Zn) status of forty-three soil quality benchmark sites in Alberta.*
5. *Analyses of five years of soil data from the AESA soil quality benchmark sites.*

This ongoing study includes forty-three benchmark sites distributed across the agricultural regions of Alberta. The sites are located in seven ecoregions, namely: Peace Lowlands (PL); Mixed Boreal Upland (MB); Boreal Transition (BT); Aspen Parkland (AP); Moist Mixed Grassland (MM); Fescue Grassland (FG) and Mixed Grassland (MG). These ecoregions fall within the Boreal Plains and Prairie ecozones (Figure 1). A description of the ecoregions can be found in *A National Ecological Framework for Canada* (Ecological Stratification Working Group, 1995). Each site has been characterized in detail with respect to landform, soil profile and physical and chemical properties at an upper, mid, and lower slope position along a catena (Report No. 1 above). Historical management information was recorded and information on current management practices is collected each year from the cooperating farmers. Soil and crop samples are taken from upper, mid and lower slope positions each year to monitor soil fertility, crop yield and nutrient uptake.

Soil samples taken in the fall of 2002 were analyzed for thirty elements. This report describes the influence of ecoregions, soil properties, and historic management practices on boron (B), chloride (Cl), cobalt (Co), molybdenum (Mo), nickel (Ni), silicon (Si), chromium (Cr), cadmium (Cd), and selenium (Se) [Appendix 1 and 2]. The data for the additional twenty-one elements are presented in Appendices 3 and 4, but are not discussed in this report. Report Number 4 above discusses the results of copper, iron, manganese, and zinc analyses on samples taken in 2000.

This broad scan of the micronutrient and trace element status of the Soil Quality Benchmark Sites provides useful baseline information regarding the variability and range of element concentrations within ecoregions, soil types and landscapes. However, the literature for many of the elements does not provide a basis to assess their status as deficient, normal or high. Of the nine elements discussed in this report, only B and Cl are routinely analysed in this region (the Northern Great Plains). There is limited information for some of the other elements, but generally not for the extraction methods used in this study.

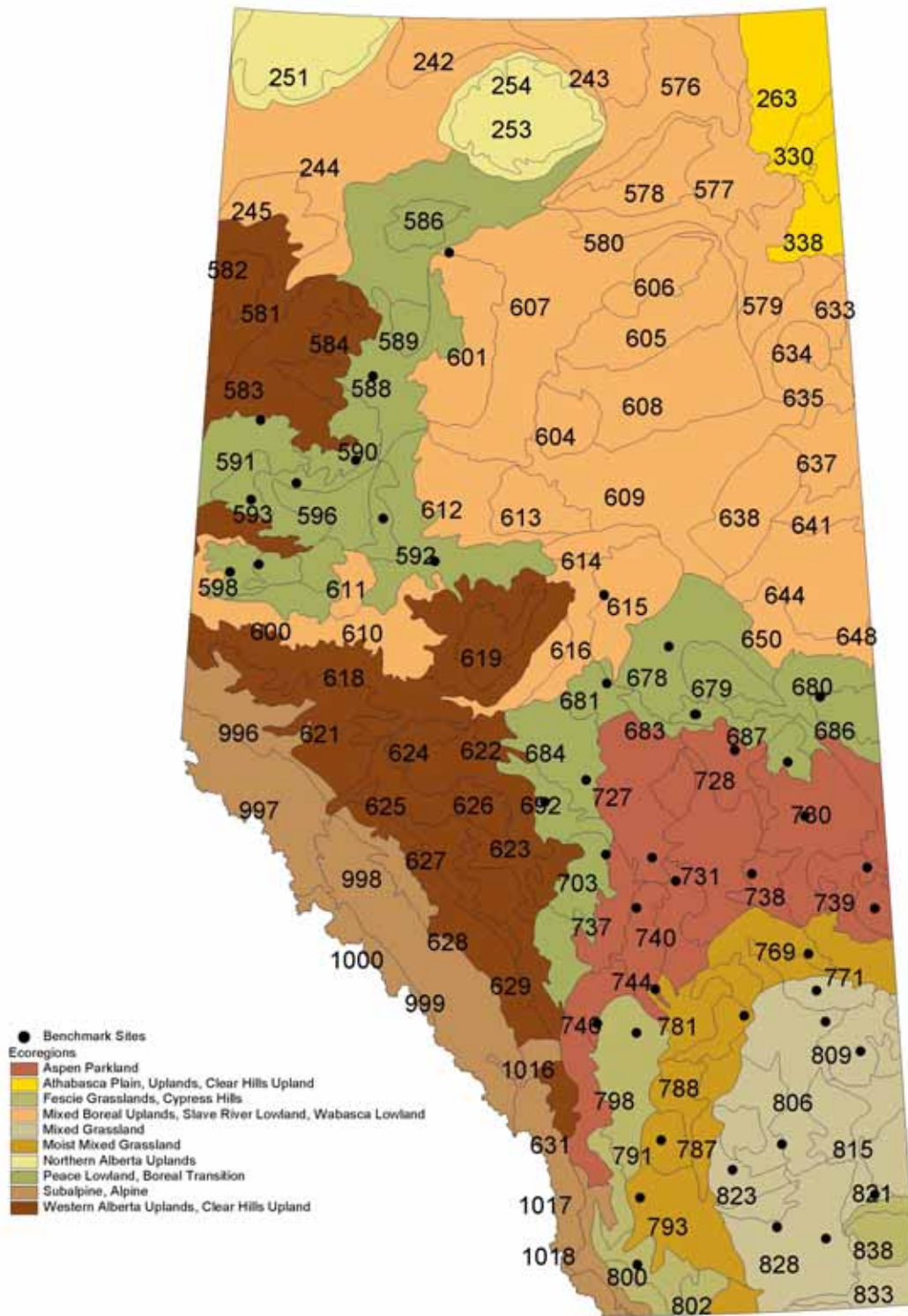


Figure 1. Location of 43 benchmark sites across Alberta.

2.0 OBJECTIVES

The objectives of this report were to describe and evaluate the micronutrient and trace element status of the benchmark sites with respect to:

1. Ecozones and Ecoregions;
2. Site characteristics – soil/landform, pedology, and physical and chemical properties;
3. Cropping and soil management history;
4. Typical values reported for Alberta, the Northern Great Plains, and other regions of the world;
5. Potential deficiencies or toxicities for crop production;
6. Their availability to crops as influenced by soil properties such as pH, OM, texture, free lime and other nutrients.

3.0 BACKGROUND

Nutrients essential for plant growth are categorized as macronutrients and micronutrients. Micronutrients are just as essential as macronutrients but are required by plants in smaller amounts. There are eight essential micronutrients (iron, zinc, copper, manganese, boron, chloride, molybdenum and nickel) plus others that are considered to be beneficial (sodium, silicon and vanadium). Cobalt is also included, since it is required for nitrogen fixation by microorganisms (Rhizobia and blue-green algae).

It has been stated that micronutrient deficiencies are less common in Alberta than in many other regions of the world. This statement is generally true for the Northern Great Plains Region of North America. For example, it is estimated that 40 percent of the worlds cultivated soils are low in available iron (Shorrocks, 1984) whereas in Alberta, iron deficiency has only been observed on trees, shrubs and ornamental plants adapted to acid soils (McKenzie, 1992). The reasons generally given for the relatively low frequency of micronutrient deficiencies in this region are:

1. Our soils are not highly weathered because they are: i) geologically young (formed since the last glacial period – 10,000 plus years ago); and ii) in a temperate climate with low precipitation, which results in a slow rate of weathering.
2. Our soils have only been cultivated for 50 to 100 years compared to hundreds and thousands of years for many agricultural soils. Therefore, there has been less crop removal.

4.0 METHODOLOGY

4.1 Soil Sampling and Analyses

The site selection and sampling methods used for the benchmark sites were described in Leskiw, et al. (2000). Each site consisted of three sampling locations (upper, mid and lower slope positions) along a catena and from two depths (0-15 cm and 15-30 cm). Therefore, a total of 129 samples were collected from 43 sites for each sampling depth. Soil samples from three or four

principle horizons (A, B, BC and/or C) were collected as part of the site characterization. The analyses performed (Norwest Labs, Edmonton) included: particle size by hydrometer (texture), CEC, pH in CaCl₂ and H₂O, EC in saturated paste extract, SAR was calculated from soluble Ca, Mg, and Na ions of the saturated paste (when EC was >4), total N, organic carbon and CaCO₃. Bulk densities in topsoil (3 cm to 15 cm) and subsoil (20 cm to 50 cm) were determined on duplicate samples by CAN-AG Enterprises Ltd.

Composite samples (5 to 10 cores) for 0 – 15 cm and 15 – 30 cm depths are taken each year for soil fertility analyses [NH₄, NO₃, P, K, SO₄, pH, EC and organic carbon (OC)]. In 2002, these samples were also analysed for 30 micronutrients and trace elements.

Chloride was extracted in 0.01 M Ca(NO₃)₂ (*Extraction based on Soil Science Society of America Book Series No. 3. Soil Testing and Plant Analysis, 1990. Chapter 10, Testing soils for S, B, Mo, and Cl, pp 265-273*). Chloride was analyzed by colorimetric centripetal analyzer (*Analysis based on American Public Health Association. Standard Method for the Examination of Water and Wastewater, 20th ed., 1998. APHA 4500-ClE, Automated Ferricyanide Method*).

The elements Al, Sb, As, Ba, Be, Bi, B, Cd, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Mo, Ni, P, Se, Si, Ag, Sr, S, Sn, Ti, Tl, V and Zn were extracted with DTPA-TEA (*Method 4.65. J.A. McKeague. Manual on Soil Sampling and Methods of Analysis, 1978*). The elements Sb, As, B, Se, Co, Cu, Pb, Mo, Ni, Si and Zn were extracted with hot water (*Method 4.61, Hot Water Sol. B – Azomethine-H method. J.A. McKeague. Manual of Soil Sampling and Methods of Analysis, 1978*). The analysis of both the DTPA-TEA and hot water extracts were based on the American Public Health Assoc. – Standard Methods for Examination of Water and Wastewater, 20th ed., 1998. APHA 3120B, Inductively Coupled Plasma (ICP) method.

Total Se was determined by a hydride AA method on aqua-regia digests.

In this report, discussion and comparisons are based on the hot water extractable B, Mo, and Si; DTPA extractable Ni, Co, Cr and Cd; 0.01 M Ca(NO₃)₂ extractable Cl and total Se. Data for all the other elements are presented in Appendices 3 and 4, but are not discussed in this report.

While a single soil test is not always definitive in identifying deficient or toxic levels of nutrients for crops, they are useful in categorizing soils into deficient, marginal and adequate ranges. Whether or not deficiencies or toxicities occur is influenced by soil properties, crop type, and variety and management practices. The micronutrient status of the benchmark sites is discussed in relations to other soil properties, differences among ecoregions, slope positions and management practices. However, it is important to recognize that critical levels are arbitrary. A wide range of critical levels for extractable micronutrients has been reported (Mortvedt et al., 1991). For many of the elements discussed in this report, critical levels have not been established for the methods used.

4.2 Data Analyses

1. Descriptive statistical procedures (mean, median, max, min, standard deviation, etc.) were conducted on the micronutrients plus selected soil properties (Appendix 2). The soil properties used in the analyses were selected from a review of the literature, which

has identified soil properties that affect micronutrient availability. Analysis of variance was conducted using the General Linear Model (GLM) procedure in SAS (1999) to determine if significant differences ($p \leq 0.05$) in micronutrients and selected soil properties occurred among ecoregions, slope positions, etc. Where significant differences were found, Tukey's Studentized Range Test (unbalanced design) was used for mean comparisons ($p \leq 0.05$).

2. The frequency (%) of element concentrations that could be potentially deficient or toxic was reviewed overall and by ecoregion.
3. Correlation:
 - Correlation was used to identify relationships with soil properties and other trace elements.
4. As part of the Soil Quality Benchmark study, the farmer co-operators were asked to complete information sheets on the management history of the sites. This information has not yet been compiled and in some cases is incomplete. A preliminary assessment of the information was undertaken with the following objectives:
 - To determine if cropping history (number of years the land has been cultivated, crop rotation and type, frequency of summer fallow, etc.) influenced micronutrient levels;
 - To determine if management practices (fertilizer rate and type, and manure application) influenced micronutrient levels.

5.0 RESULTS AND DISCUSSION

5.1 Background

Soils are the primary source of trace elements for plants and through feed and food crops, for animals and humans. Trace element problems (deficiencies or toxicities) are therefore generally associated with soil properties on a regional or local basis.

The availability of trace elements to plants is influenced by both parent material and soil development, but soil properties can operate very differently for different trace elements. For example, high concentrations of Mo are found only in plants growing on poorly drained soils, whereas poorly drained or poorly aerated soils tend to produce plants with low Se concentration. The trace element requirements and tolerances of plants differ from those of animals and humans, to the extent that, deficiencies or toxicities in plants do not necessarily translate into deficiencies or toxicities in animals or humans. For example:

1. Higher plants can produce optimum growth and have Se and I concentrations that are deficient for animals and humans.
2. Some plants growing on high Se soils can accumulate Se concentrations that are toxic to grazing animals.
3. B toxicity in plants is common in some arid regions of the world but B toxicity is rare in animals or humans.

4. The trace elements I, F, Se, Co, As, Li, Cr, Si, Sn, and V are considered essential for animals and humans but not for plants.

5.2 Identifying Deficiencies and Toxicities

Various approaches have been used for identifying and mapping trace element problems. Early attempts (in the 1940's and 1950's in the USA) consisted mainly of literature reviews and personal communication among soil scientists, agronomists, and animal nutritionists. This led to mapping of data from plant and feed analysis laboratories. In some cases, geographical and soil association maps were used to select sampling sites for specific crops and to identify areas where deficiencies or imbalances in trace elements were suspected. In Alberta, general areas of Se deficiency have been delineated from analysis of forage samples. Se levels in forage samples analysed from 1970 to 1991 have been mapped by legal location (Corbett, 2004).

Mapping of trace element problems from data generated by routine soil analysis for fertility managements has been limited in that:

1. Trace elements are not often analysed in routine soil testing;
2. For many of the trace elements, deficiency and toxicity criteria are not well defined.

As was identified in the report on, "The Cu, Fe, Mn, and Zn Status of the ASEA Soil Quality Benchmark Sites", composite samples of fields taken for routine soil analysis can mask variation that occurs within fields. At some sites, Cu and Zn levels ranged from deficient to highly adequate within the three slope positions sampled along a catena.

5.3 Boron (B)

B is essential to plants and is taken up as H_3BO_3 (boric acid). There is increasing evidence that it may be required for normal mineral metabolism in mammals (Welch et al., 1991). B deficiency does not follow well-defined geographic patterns related to soils. Deficiencies are widespread throughout the world and typically occur on well-drained light textured soils that are low in soil organic matter (SOM).

Crops vary widely in their susceptibility to B deficiency. Monocotyledons generally have lower B requirements than dicotyledons. Crops with high B requirements include alfalfa, beets, turnips, canola and apples. B deficiency may occur when plant B content is < 15 mg/kg on a dry matter basis but critical values ranging from 5 to 30 mg/kg have been reported.

Toxicity can occur when the B content of plants exceeds 200 mg/kg although there are reports of corn tolerating in excess of 1000 mg/kg and barley seedlings being impaired at 80 mg/kg. B toxicity in plants is fairly common in semiarid regions with alkaline soil but B toxicity has seldom been reported in Canada. B toxicity in animals is primarily an experimental phenomenon but Underwood (1977) reported B toxicity in lambs grazing high-B plants growing on solonetz and solonchak soils in Russia.

Agronomists in Alberta have occasionally reported seeing B deficiency symptoms on alfalfa and canola, but documented responses to B fertilization are rare. Nyborg and Hoyt (1970) obtained response to B fertilization of turnip rape in greenhouse studies with Grey Luvisols in the Peace River region. Poor seed set of turnip rape on some Grey Luvisols in the region was attributed to

B deficiency. B deficiency symptoms on alfalfa and response to B fertilization were observed on a light textured Luvisol in the Barrhead area (Dowbenko, R., personal communication).

5.3.1 Boron Results from Benchmark Sites

The hot water extractable B for the 129 sampling locations (43 sites x 3 slope positions) in this study:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	0.92	0.29	2.32	0.4	43
15-30	0.91	0.12	3.22	0.53	48

Sixteen percent of the samples were in the marginal to deficient range (≤ 0.5 mg/kg) and there were no samples in the toxic range (> 5 mg/kg). Various extension bulletins have indicated there may be potential toxicity to plants at soil B levels of 3 to 5 mg/kg (Marx et al, 1996; Rehm et al., 1993). However, critical levels of B are difficult to establish as plants differ in the amount of B they require.

Effect of Soil Properties

As indicated earlier, B deficiency does not tend to follow well-defined geographic patterns although deficiencies tend to occur on low organic matter, light textured soils. In this study, low B values tended to occur on light textured soils but some low values also occurred on loam and clay loam soils. Hot water extractable B (HWEB) was significantly correlated with OC ($r = 0.53$) [Table 1]. The mean OC content of samples in the marginal to deficient range was low (1.6 %).

Effect of Ecoregion

The mean HWEB was highest in Ecoregions PL, AP and FG and lowest in Ecoregions MM and MG (Table 2). B was significantly lower in Ecoregions MM and MG, than in the other ecoregions. However, the frequency of low and marginal B values (≤ 0.5 mg/kg) in the MM and MG Ecoregions was low compared to the other ecoregions. This is because standard deviations (SD) were lower in these two ecoregions than in other ecoregion (SD = 0.18 and 0.13 in MM and MG respectively, compared to 0.3 to 0.4 in the other ecoregions for the 0-15 cm depth). The BT Ecoregion had the highest frequency of marginal or deficient values (5 of 8 sites; sites 680, 681, 684, 687 and 703). The MG Ecoregion had the lowest mean B content (0.73 mg/kg) but only one of the eight sites had marginal B values. The SD in the MG Ecoregion was low (Table 3).

Table 1. Correlation coefficients where $r > 0.5$.

	B	Cl	Mo	Ni	Co	Si	Cr	Cd	Se	Sand	Silt	Clay	CEC	CaCO ₃	OC	P	K	pHw	pHc
B	1.0														0.53				
Cl		1.0																	
Mo			1.0															0.72	0.62
Ni				1.0	0.55			0.69					0.63		0.46				
Co				0.55	1.0													0.55	
Si						1.0													
Cr							1.0												
Cd				0.69				1.0											
Se									1.0				0.54		0.55				
Sand										1.0									
Silt											1.0								
Clay												1.0							
CEC				0.63					0.54				1.0						
CaCO₃														1.0					
OC	0.53			0.46					0.55						1.0				
P																1.0			
K																	1.0		
pHw			0.72		0.55													1.0	
pHc			0.62																1.0

Table 2. Mean micronutrient and trace element values for seven ecoregions.

Ecoregion	No. of Sites	B ¹	Cl ²	Mo ¹	Ni ³	Co ³	Si ¹	Cr ³	Cd ³	Se ⁴
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
0-15 cm										
PL	10	1.05ab [#]	11.5	0.020ab	2.23	0.163	167	0.008	0.173ab	0.650
BT	8	0.79b	9.6	0.013b	1.99	0.242	117	0.010	0.125b	0.396
MB	1	1.54	10.1	0.067	1.27	0.171	234	0.009	0.234	0.500
AP	9	1.00ab	12.7	0.022ab	2.33	0.272	120	0.011	0.177ab	0.493
MM	5	0.76b	5.5	0.025ab	1.78	0.255	127	0.011	0.194ab	0.427
FG	2	1.36a	13.0	0.018ab	2.96	0.214	149	0.008	0.278a	0.483
MG	8	0.73b	9.0	0.051a	1.42	0.131	131	0.009	0.103b	0.346
15-30 cm										
PL	10	1.22	9.9	0.029	1.97	0.091	429	0.008	0.086b	0.690
BT	8	0.75	7.3	0.011	1.37	0.102	141	0.008	0.051b	0.388
MB	1	1.36	6.2	0.056	1.04	0.094	215	0.009	0.152	0.500
AP	9	0.95	8.8	0.025	1.98	0.132	73	0.009	0.104b	0.441
MM	5	0.67	4.8	0.022	1.51	0.139	156	0.009	0.125b	0.433
FG	2	1.20	11.6	0.023	2.57	0.170	120	0.008	0.204a	0.500
MG	8	0.66	7.6	0.053	1.42	0.102	120	0.008	0.075b	0.342

¹ Hot water extractable² 0.01 M Ca(NO₃)₂ extractable³ DTPA extractable⁴ Total[#] means followed by different letters are significantly different at $P < 0.05$ based on SNK means separation test

Table 3. Average standard deviation of micronutrient and trace element values for seven ecoregions.

Ecoregion	No. of Sites	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
0-15 cm										
PL	10	0.40	6.81	0.02	1.12	0.11	133	0.001	0.12	0.37
BT	8	0.31	5.2	0.013	1.40	0.152	93	0.003	0.113	0.253
MB*	1	.	.	.	.	.	.	.	.	.
AP	9	0.43	13.2	0.019	0.87	0.149	87	0.002	0.059	0.159
MM	5	0.18	4.3	0.020	0.67	0.212	53	0.003	0.091	0.364
FG	2	0.38	13.2	0.006	1.93	0.140	66	0.0005	0.064	0.024
MG	8	0.13	6.3	0.032	0.43	0.050	80	0.003	0.052	0.096
15-30 cm										
PL	10	0.75	6.14	0.05	1.48	0.07	570	0.002	0.10	0.47
BT	8	0.33	4.9	0.008	0.85	0.058	159	0.002	0.033	0.326
MB*	1	.	.	.	.	.	.	.	.	.
AP	9	0.57	7.3	0.022	1.03	0.084	39	0.003	0.051	0.169
MM	5	0.23	3.4	0.014	0.63	0.094	125	0.002	0.071	0.374
FG	2	0.20	8.0	0.011	1.86	0.108	55	0.001	0.071	0.094
MG	8	0.15	7.3	0.034	0.40	0.031	96	0.001	0.032	0.097

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

* MB excluded from statistical analysis because it contains only 1 site

Effect of Slope Position

The mean HWEB concentrations were significantly lower in the upper and mid slope positions than on the lower slope positions in the 0 -15 cm depth, but there was no significant difference among slope positions for the 15-30 cm depth (Table 4). The higher B levels in the lower slope positions were generally associated with higher levels of OC. Also, B in soil solution occurs as relatively mobile anions and can therefore move laterally with soil water into lower slope positions.

Effect of Management

To the extent that tillage and cropping practices influence SOM, management could influence B availability. There was no indication in the management information, that B fertilizer was applied at any of the sites.

Table 4. Effect of slope position on selected micronutrients and trace elements from 43 benchmarks.

Slope Position	Sample Depth (cm)	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
U	0-15	0.94b*	9.7	0.033	1.73b	0.171b	120b	0.009	0.150b	0.42b
M	0-15	1.02b	9.8	0.028	1.86b	0.193b	176a	0.010	0.17b	0.47ab
L	0-15	1.15a	11.2	0.031	2.4a	0.257a	152ab	0.009	0.231a	0.52a
U	15-30	0.92	8.5	0.031	1.46b	0.1b	182	0.009	0.085b	0.48
M	15-30	0.94	7.1	0.033	1.65ab	0.104b	189	0.009	0.1b	0.45
L	15-30	1.05	8.5	0.029	1.98a	0.152a	167	0.008	0.157a	0.49

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

* For each sample depth, means followed by a different letter are significantly different at P<0.05 based on SNK means separation

5.4 Chlorine (Cl)

Cl has been recognized as an essential plant nutrient for many years (Romheld and Marschner, 1991), but since it is abundant in the environment (both lithosphere and atmosphere), deficiencies in the field were generally thought to be rare. However, more recent work by Christensen et al. (1981), Fixen et al. (1986), and others has found prophylactic and beneficial properties of the element. Low rainfall, little or no need for K fertilizer (KCl), and the large land locked geography of the Northern Great Plains region have been cited as reasons for relatively frequent reports of response to Cl fertilization. (Note: land locked regions receive low levels of Cl in precipitation compared to coastal regions).

Plants utilize chlorine as the Cl⁻ anion. In soils, common Cl salts are highly soluble and Cl⁻ is highly mobile. Less than 45 kg/ha Cl in the 0-60 cm depth (approx. 12 mg/kg in the 0-15 cm depth) has been reported to be deficient in the Northern Great Plains region (Fixen et al., 1986). Crop response to Cl in the Northern Great Plains Region appears to result from prophylactic or beneficial effects rather than its function as an essential plant nutrient.

5.4.1 Chlorine Results from Benchmark Sites

The 0.01 M Ca(NO₃)₂ extractable Cl⁻ for the 129 sampling locations:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	10.3	2.2	74.7	8.8	85.4
15-30	8.2	1.2	32.0	6.5	79.3

Forty one percent of the samples were below the critical level of 12 mg/kg (0-30 cm) and none of the samples were in the toxic range.

Effect of Soil Properties

Chloride levels in this study were not significantly correlated with soil properties nor the other elements assessed in this report (Table 1).

Effect of Ecoregion

The MM Ecoregion had the lowest Cl levels but there were no significant differences among ecoregions (Table 2). The MM Ecoregion was the only one with a mean Cl level below the critical levels of 12 mg/kg. The percentage of sampling locations with Cl levels below the critical level ranged from 17 % in the PL ecoregion to 73 % in the MM Ecoregion.

Effect of Slope Position

There were no significant differences in Cl levels among slope positions (Table 4). Low Cl values were more strongly associated with sites than with slope position or ecoregion. Sites 681, 688, 730, 739, 743, 746, 769, 786, 791, 793, 804, 815 and 2828 had Cl values below the critical level in all three-slope positions. At 14 of the 43 sites (33 %), the mean Cl level of the three slope positions was below the critical level. Overall, 53 of the 129 sampling locations (41 %) were below the critical level.

Effect of Management

Management practices that include the use of fertilizers containing KCl or manure could significantly increase soil Cl levels.

5.5 Molybdenum (Mo)

Mo is an essential element for both plants and animals. In plants, it is taken up as MoO_4^{2-} and is involved in NO_3 reduction, protein synthesis and biological N_2 fixation. In animals, both deficiencies and toxicities have been reported. Excess Mo causes diarrhea of cattle (teart scours) in England. In the Inter-lakes Region of Manitoba, high Mo in association with low Cu has been reported to cause Mo toxicity (molybdenosis) in cattle (Corbett, R., personal communication). More recent work has indicated that Mo supplementation in human diets may have anticarcinogenic benefits (Miller et al., 1991).

Mo in soils has not been extensively researched, in large part because deficiencies are rare. Mo availability to plants is strongly affected by soil pH. Availability increases as pH increases. Therefore, Mo deficiency in acid soils is often corrected by liming.

Acid ammonium oxalate (AAO) is the soil test extractant most commonly used for Mo (Sims and Johnson, 1991). A level of >0.2 mg/kg AAO extractable Mo has been indicated as adequate. However, Johnson and Fixen (1990) state that, "Critical levels of extractable available Mo remain unknown for lack of suitable extraction reagent or Mo deficient soil. Identifying critical levels is made more difficult by the fact that plant response in marginally deficient soils appears to be more influenced by liming than by application of Mo". Critical levels for hot water or DTPA extractable Mo, used in this study, have not been established.

5.5.1 Molybdenum Results from the Benchmark Sites

The hot water extractable Mo for the 129 sampling locations:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	0.026	0.004	0.153	0.029	112
15-30	0.029	0.004	0.374	0.041	141

The extractable Mo value of 0.004 was the detection limit and occurred quite frequently. Values above 0.100 occurred infrequently. The high values did not occur on sandy soils with low Cu, which would indicate a potential for Mo toxicity in grazing cattle or sheep (molybdenosis). (Note regarding the high CV: It may be useful to examine plant tissue levels at some sites to determine if toxicities or deficiencies could occur.)

Effect of Soil Properties

Extractable Mo was significantly correlated with soil pH_w ($r = 0.72$) and pH_c ($r = 0.62$), but not with other soil properties, or with the other elements examined in this study (Table 1).

Effect of Ecoregion

The mean extractable Mo in the 0-15 cm depth ranged from 0.013 mg/kg in the BT Ecoregion to 0.051 mg/kg in the MG Ecoregion but there were no significant differences among other ecoregions (Table 2).

Effect of Slope Position

Differences in extractable Mo among slope positions were small and not significant (Table 4).

Effect of Management

There was no indication of management effects on extractable Mo, although liming could increase Mo availability on acid soils.

5.6 Nickel (Ni)

The main interest in Ni has concerned its toxic effects on plant, but more recent research has indicated Ni requirements for both plants and animals. Asher (1991) discusses the role of Ni in a chapter in "Micronutrients in Agriculture", entitled "Beneficial Elements, Functional Nutrients and Possible New Essential Elements". Depending on the reference, Ni is considered as either a functional or essential nutrient. Havlin et al. (1999) stated that Ni is the latest nutrient to be established as essential for plants. It is taken up by plants as Ni^{2+} and has been shown to be required for urea reduction (Dixon et al., 1975) and for grain viability of barley (Brown et al., 1987).

Critical soil levels for Ni deficiency were not identified. However, Asher (1991) lists toxic levels (DTPA extractable) for various grasses ranging from 6 mg/kg for Bermuda grass (*Cynodon dactylon*) to 112 mg/kg for pangola grass (*Digitaria decumbens*). Toxic symptoms have been described as being similar to Fe deficiency. In cereals and grasses, variation in chlorosis along the length of the leaf gives a characteristic transverse banding effect. Risser and Baker (1990) state that, “most background levels in soils and plants are of little concern for human health, since inhibition of plant growth and development by excess Ni places a limit on Ni entering the food chain”.

5.6.1 Nickel Results from the Benchmark Sites

The DTPA extractable Ni for the 129 sampling locations:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	2.01	0.51	5.87	1.11	55.22
15-30	0.029	0.004	0.374	0.041	141.38

If 6 mg/kg is used as the critical toxic level (reported as the toxic level for Bermuda grass -a sensitive species) none of the values fall in the toxic range. A critical deficient value could not be identified.

Effect of Soil Properties

Ni was significantly correlated with the soil properties CEC ($r = 0.63$) and OC ($r = 0.46$), and with Co ($r = 0.55$) and Cd ($r = 0.69$) (Table 1).

Effect of Ecoregion

There were no significant differences in DTPA extractable Ni levels among ecoregions (Table 2). Values ranged from 1.42 in the MG ecoregion to 2.96 in the FG ecoregion.

Effect of Slope Position

Extractable Ni was significantly higher in the lower slope positions than in the mid or upper slopes (Table 4). This is likely related to higher levels of SOM in the lower slopes.

Effect of Management

Management practises that increase SOM could increase extractable Ni.

5.7 Cobalt (Co)

Cobalt was established as an essential nutrient for animals in the late 1930's and for plants in 1960 (Asher, 1991). Co is essential for ruminant animals. Rumen microflora require Co for

synthesis of vitamin B₁₂. Co deficiency in ruminants is usually corrected by using Co fortified salt licks, adding it to drinking water, or by using Co boluses. Co fortified salt is commonly used in Alberta, although there are no reports of Co deficiency (Corbett, R., personal communication).

In plants, Co is essential for N₂ fixation by leguminous plants. Co has not been shown to be essential for plants, which are not dependent on N₂ fixation, but beneficial effects have been reported for several crops. Plants take it up as Co²⁺.

Total Co content of soils typically ranges from 1 to 10 ppm and average about 8 ppm. Forages produced on soils containing < 5 ppm of total Co often results in Co deficiency in ruminants. Soils prone to Co deficiency include (1) acidic, highly leached sandy soils; (2) some calcareous soils; and (3) some peaty soils (Havlin et al., 1999). A critical deficiency level for DTPA extractable Co was not identified.

5.7.1 Cobalt Results from Benchmark Sites

The DTPA extractable Co for the 129 sampling locations:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	0.208	0.034	0.847	0.151	72.6
15-30	0.113	0.019	0.419	0.075	33.4

Effect of Soil Properties

Co was significantly correlated with pHw (r = 0.55) and Ni (r = 0.55) (Table 1).

Effect of Ecoregion

There were no significant differences in DTPA extractable Co among ecoregions (Table 2).

Effects of Slope Position

Extractable Co was significantly higher in the lower slope positions than the upper and mid slope positions in both the 0-15 cm and 15-30 cm samples (Table 4).

Effects of Management

There were no apparent effects of management on extractable Co.

5.8 Silicon (Si)

Welch et al. (1991) stated “since 1970, eleven additional trace elements have been proposed to be required by animals and possibly humans”. They include As, B, Br, Cd, F, Pb, Li, Ni, **Si**, Sn and V. Except for Ni and B, none are considered to be essential for higher plants. Si is regarded

as an essential trace element for normal growth and development in animals, where it is involved in the formation of bone and cartilage.

While an essential role for silicon in plants has not been established, many beneficial effects have been reported. Si is absorbed by plants as silicic acid (H_4SiO_4). Cereals and grass typically contain 0.2 to 2 % Si on a dry weight basis. Accumulator plants such as horsetail can accumulate up to 20 % Si (DW). Rice is often supplemented with Si when the Si content in the straw falls below 11 %.

Si impregnates walls of epidermal and vascular tissue. Reported beneficial effects include: correction of soil toxicities of Mn, Fe and Al, disease resistance, greater stalk strength and lodging resistance, increased P availability and reduced transpiration (drought resistance).

Si is the second most abundant element in the earth's crust, averaging 28 %. Soils range between 28 % and 35 %. The main Si species in soil solution is silicic acid (H_4SiO_4). Levels of 3 ppm to 37 ppm Si in solution have been reported for normal soils. Less than 0.9 to 2 ppm in soil solution is considered deficient for sugarcane. An adequate level for rice is considered to be >100 ppm (Havlin et al., 1999).

5.8.1 Silicon Results from the Benchmark Sites

Hot water extractable Si values for the 129 sampling locations:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	137	12	858	109	79.6
15-30	192	15	1970	322	167.7

(Note: values over 1000 mg/kg occurred at 3 sites in the PL ecoregion)

Effect of Soil Properties

Si was not significantly correlated with soil properties, nor the other elements discussed in this report (Table 1).

Effect of Ecoregion

There were no significant differences in hot water extractable Si among ecoregions (Table 2).

Effect of Slope Position

Extractable Si in the 0-15 cm samples was significantly higher in the mid slope than in the upper slope position. There were no significant differences among slope positions in the 15-30 cm samples (Table 4).

Effect of Management

There were no apparent effects of management on extractable Si. Cereal straw contains relatively large amounts of Si. Straw removal could contribute to reduced soil Si levels in the long term.

5.9 Chromium (Cr)

The metals generally considered as toxic include: Cd, **Cr**, Hg, Ni, and Pb. Cr and Ni are the most phytotoxic. These metals are economically important and used in substantial quantities, thus providing the possibility of soil and plant contamination from anthropogenic sources such as mining and waste disposal. Toxic metals are also added to soils in organic forms. The leather tanning industry is a large source of high Cr organic waste. Toxic levels can also occur naturally in soils developed on serpentine high in Cr and Ni.

Cr is toxic to plants in its common oxidation states, Cr(III) and Cr(VI). The Cr(III) cation is normally the form found in plants and is essential in human nutrition (Risser and Baker, 1990). Cr(VI) is an anion, which is mobile in soil and water and is toxic to aquatic life, microorganisms and animals. Hexavalent Cr is also a suspected human carcinogen (e.g. the movie “Erin Brokovich”).

Good relationships between chelate soil test (e.g. DTPA) and plant uptake of Cr have not been established. Reasons cited include the mineral stability and slow kinetics of Cr dissolution (Risser and Baker, 1990). Test methods used for Cr include soluble Cr(VI), organic forms and total Cr.

In animals and humans, Cr is an essential trace element required for glucose, lipid and protein metabolism. Its predominant physiological role appears to be to improve the action of insulin. In results presented at 2003 Experimental Biology Conference (Campbell et al., 2003), research suggested that low intake of Cr may be linked to insulin resistance, a condition affecting one in three Americans and associated with obesity, type 2 diabetes and cardiovascular disease. The study suggested that US diets are inadequate in Cr. Research on cattle at the University of Guelph in Ontario by Mowat and Mallard (1993) has shown Cr supplementation during the first 21 – 29 days in feedlots improved weight gain and reduced morbidity or sickness due to bovine respiratory disease complex (also known as shipping fever).

5.9.1 Chromium Results from the Benchmark Sites

DTPA extractable Cr values for the 129 sampling locations were:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	0.010	0.005	0.027	0.003	30
15-30	0.008	0.004	0.017	0.002	25

Effect of Soil Properties

Cr was not significantly correlated with soil properties nor the other elements discussed in this report (Table 1).

Effect of Ecoregion

There were no significant differences in DTPA extractable Cr among ecoregions (Table 2). The total range in extractable Cr was small.

Effect of Slope Position

There were no significant differences in extractable Cr among slope positions (Table 4).

Effect of Management

There was no indication of industrial or municipal waste application at any of the benchmark sites. Therefore, toxic levels of Cr are not a concern.

5.10 Cadmium (Cd)

As referred to earlier (Welch et al., 1991), As, B, Br, **Cd**, F, Pb, Li, Ni, Sn, and V have been proposed as being required by animals and possibly humans. Beneficial effects, such as suppression of powdery mildew in crop, have also been reported for Cd. However, the main interest in Cd has been toxic concentrations in food and feed resulting from application of sewage sludge and phosphate fertilizers high in Cd.

Reports of Cd uptake by crops are highly variable, depending on crop type and soil conditions. Most field crops do not absorb appreciable quantities of Cd, but leafy vegetables such as spinach and swiss chard are known to accumulate Cd. One of the earliest reports of Cd toxicity in people was traced to the flooding of rice with water that drained from a mine (Welch et al., 1991). The concentration of Cd in corn forage was not affected by Zn fertilizer, containing from 1 to 2165 mg Cd kg⁻¹ (Mortvedt, 1991).

Soil pH is a dominant factor affecting Cd availability. Availability increases as pH decreases. Sludge application is usually restricted to soils of pH 6.5 or above and rates are generally based on CEC.

Although some significant correlation of Cd uptake with DTPA extractable Cd have been reported, no critical values were given. Limitations for Cd application to soils are generally based on maximum accumulative loading. Maximum loading limits range from 2.5 to 5.0 lb Cd ac⁻¹ based on soil texture (Risser and Baker, 1990). For fertilizers, risk based concentrations have been established. For diammonium phosphate, the safe level is 736 ppm (The Fertilizer Institute, 2000). Reported levels of Cd in diammonium phosphate in the U.S.A. show levels no higher than 200 ppm.

5.10.1 Cadmium Results from the Benchmark Sites

DTPA extractable Cd values for the 129 sampling locations were:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	0.161	0.026	0.660	0.108	67.1
15-30	0.093	0.004	0.634	0.087	93.6

Effect of Soil Properties

DTPA extractable Cd was not correlated with any of the soil properties, but was significantly correlated with Ni ($r = 0.69$) (Table 1).

Effect of Ecoregion

In the 0-15 cm depth, extractable Cd was significantly higher in the FG Ecoregion than in the MG, BT and PL Ecoregions. In the 15-30 cm depth, Cd was higher in the FG ecoregion than in all the other ecoregions. However, the highest Cd values occurred on sites PL 591 and 592, MB 615, BT 684, and MM 791 (Table 2). SD was high in the PL, BT and MM Ecoregions (Table 3).

Effect of Slope Position

Extractable Cd was higher in the lower slope position than in the upper and mid slope positions in both the 0-15 cm and 15-30 cm depths.

Effect of Management

There was no indication of industrial or municipal waste application at any of the benchmark sites. Therefore, toxic levels of Cd are not a concern.

5.11 Selenium (Se)

In the early 1930's, high concentrations of Se were identified as being responsible for animal production problems in parts of the western USA. The location of high Se areas was facilitated by collection and analysis of Se accumulator plants. The high Se soils were generally developed on shales of the Cretaceous or Permian geologic age. Crop plants and range grasses containing > 4 to 5 mg Se kg^{-1} (potentially detrimental) were generally confined to parts of fields or farms. High levels of Se in irrigation drainage water are also a concern in some areas (e.g. The Kesterson Wildlife Refuge in California).

Small areas of Se toxic soils have also been identified in Alberta, Saskatchewan and Manitoba (Fleming, 1980). Livestock deaths from Se toxicity are rare in Alberta, but have been reported in the Cypress Hills and Crowsnest Pass areas (Corbett, R., personal communication).

Se accumulator plants, such as *Astragalus* (milk vetch), the *Xylorhiza* section of *Machaeranthera* (woody aster), *Haplopappus* (goldenweed) and some *Stanleya* (Prince's plume) can contain >50 mg Se kg⁻¹. Secondary Se absorbers include *Aster*, *Atriplex*, and *Grindelia* (Fleming, 1980).

While high levels of Se in plants dominate the literature, beneficial effects to symbiotic N fixation have been reported (Munson and Nelson, 1990).

The total Se concentration in most soils ranges between 0.1 and 2 ppm and averages about 0.3 ppm (Havlin et al., 1999). The forms include: selenides (Se²⁻), elemental Se⁰, selenites (Se⁴⁺) and selenates (Se⁶⁺). Selenates are highly soluble and the main species taken up by plants. Selenites are absorbed but to a lesser extent than selenates. Organic Se can also be an important fraction, since up to 40 % of the total Se in some soils is present in humus (Havlin et al., 1999). Se deficient soils generally occur on parent material developed from igneous rock.

For mobile elements such as Se, sampling depth is important. Soltanpour et al. (1982) found that soil samples from the 0-30 cm depth were useless for predicting Se content of wheat grain but Se in the 0-90 cm depth correlated well with Se in grain.

Se deficiency, expressed as white muscle disease in livestock, is quite prevalent in Alberta. Deficiencies are generally more prevalent in the higher rainfall areas of west central Alberta, but they have not been associated with specific soil types or parent materials. Se levels in forage samples analysed from 1970 to 1991 have been mapped by legal location (Corbett, 2004).

Low Se soils are also typically deficient in S. The application of S fertilizer (especially sulphate) often reduces Se concentration in forages. Increased yield from S application causes a dilution effect (the same amount of Se in a greater mass) and competition for uptake by plants between sulphate and selenate.

5.11.1 Selenium Results from the Benchmark Sites

Total Se values for the 129 sampling locations were:

Sampling Depth (cm)	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	SD	CV (%)
0-15	0.476	0.100	1.6	0.278	58.4
15-30	0.474	0.001	2.3	0.335	70.7

The mean total values are above the normal mean value of 0.3 given by Havlin et al. (1999).

Effect of Soil Properties

Se was significantly correlated with CEC (r = 0.54) and OC (r = 0.55) (Table 1). The mean OC of the 20 locations with total Se of 0.2 or less was only 1.5 %.

Effect of Ecoregion

There were no significant differences in total Se among ecoregions (Table 2). The PL Ecoregion had the highest mean Se (0.65). The MG Ecoregion had the lowest mean Se (0.346), but the variation was low (SD = 0.096; CV = 28 %), resulting in few low Se values (≤ 0.2 mg/kg). Most of the low Se values occurred in the BT Ecoregion, which had the second lowest mean and high variation (SD = 0.253; CV = 88 %) [Table 3].

Effect of Slope Position

Differences among slope positions were relatively small, but in the 0-15 cm depth, Se was significantly higher in the lower slope than in the upper slope (Table 4).

Effect of Management

There was no indication that management practices affected total Se.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Boron

There is no evidence of toxic levels of B at any of the sites. However, a few sites have marginal to deficient levels (< 0.5 mg/kg). Plant analysis would be useful on a few sites to determine if deficient levels occur in plant tissues. Sites where there are significant differences between slope positions should be examined.

6.2 Chlorine

If the critical level of 45 kg Cl ha^{-1} (0-60 cm), identified for the Northern Great Plains Region is valid, many (approximately 40 %) of the benchmark sites are in the potentially deficient range. Limited trials in Western Canada have shown relatively small and inconsistent response to Cl fertilization (personal experience and personal communication with several researchers). Until more definitive results are available, follow-up on the benchmark sites does not appear warranted.

6.3 Molybdenum

There are no reports of Mo deficiency or toxicity in Alberta. No critical values for hot water extractable or DTPA extractable Mo were found in the literature for comparison with the values reported in this study. If further examination of soil Mo is deemed warranted, the Acid Ammonium Oxalate extraction method should be used since it is the most commonly used method reported in the literature. (Note: Mo toxicity in livestock (molybdenosis) has been reported in Manitoba).

6.4 Nickel

There was a fairly wide range in DTPA extractable Ni among the benchmark sites (0.51 to 5.87 mg/kg). The highest value (5.87) approaches the toxic level of 6 mg/kg reported for Bermuda grass. Plant analysis may be warranted on this site to determine if phytotoxicity is an issue.

6.5 Cobalt

Although there are no studies in Alberta that indicate Co deficiency in livestock (Corbett, R., personal communication), salt-licks supplemented with Co are commonly used. Further investigation of soil Co does not appear to be warranted, unless future research indicates Co deficiency for legume crops.

6.6 Silicon

The mean hot water extractable Si values of 137 mg/kg (0-15 cm) and 192 mg/kg (15-30 cm) are much higher than typical values of 3 to 37 mg/kg given for soil solution Si. This indicates that hot water extractable Si may not be comparable to soil solution Si. Plant analysis could be used to determine if plant Si is low at sites with low hot water extractable Si.

6.7 Chromium

None of the benchmark sites have received industrial or municipal wastes. Therefore, Cr toxicity is not a concern. However, given the recent reports of low Cr levels in human diets, Cr analysis of plant materials may be warranted.

6.8 Cadmium

Cadmium contamination of soils from industrial sources is not an issue, and given the Cd content of phosphate fertilizers and the relatively low rates of application used in this region, high Cd levels in crops from these sources is not a concern. However, it would be valuable to examine the Cd content of crops from a few sites with the highest DTPA extractable Cd levels.

6.9 Selenium

All of the total Se values in this study fall within the normal range of 0.1 to 2 mg/kg and the mean of 0.48 mg/kg is above the reported normal mean of 0.3 mg/kg. However, given the prevalence of Se deficiency in livestock in Alberta, it is likely that some of the sites are deficient. Analysis of plant material from some of the sites with low soil Se is recommended.

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8.0 APPENDIX

Note: The broad scan of the micronutrient and trace element status of the Soil Quality Benchmark Sites done for this study provides baseline information regarding variability and ranges of element concentrations within ecoregions, soil types and landscapes. However, there is no basis to assess their status as deficient, normal or high.

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites.

Appendix 2. Descriptive statistics (mean, min, max and standard deviation) for selected micronutrients and trace elements of upper, mid and lower slope positions in seven ecoregions.

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth).

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth).

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites.

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
586	PL	U	0-15	Judah	D. GL	L	CL	1.22	11.7	0.015	1.99	0.060	76.6	0.007	0.288	0.70	31.6	3.5	39	6.8
586		U	15-30					1.37	18.3	0.016	1.25	0.045	584	0.011	0.015	1.10				
586	PL	M	0-15	glJudah	GLD. GL	L	SiCL	1.58	15.8	0.022	1.93	0.049	195	0.007	0.298	1.00	37.6	4.3	40	6.7
586		M	15-30					1.59	12.9	0.018	2.44	0.029	51.4	0.008	0.036	0.70				
586	PL	L	0-15	glJudah	GLD. GL	L	SiCL	1.26	9.8	0.012	1.74	0.076	86.5	0.006	0.170	0.70	35.6	3.0	28	6.2
586		L	15-30					1.31	16.6	0.020	1.50	0.059	68.5	0.007	0.093	0.90				
588	PL	U	0-15	Kathleen	O. GL	L	CL	0.974	19.3	0.036	0.826	0.040	81.2	0.007	0.026	0.40	53.6	2.3	12	8.4
588		U	15-30					1.11	3.3	0.016	0.370	0.030	30.3	0.010	0.022	0.30				
588	PL	M	0-15	Judah	D. GL	L	SiCL	1.04	4.6	0.057	0.649	0.034	73.7	0.009	0.052	0.40	39.6	3.0	24	8.2
588		M	15-30					0.483	2.2	0.058	0.753	0.041	41.0	0.009	0.061	0.3				
588	PL	L	0-15	glJudah	GLD. GL	L	CL	1.25	3.9	0.015	1.37	0.100	94.8	0.008	0.099	0.3	53.6	2.8	39	7.4
588		L	15-30					1.12	3.9	0.012	1.04	0.060	72.4	0.008	0.056	0.3				
590	PL	U	0-15	Berwyn	D. GL	M	L	1.00	21.2	0.004	1.26	0.136	70.4	0.010	0.102	0.2	23.6	2.5	23	6.8
590		U	15-30					0.718	7.2	0.023	0.810	0.169	35.5	0.007	0.004	0.30				
590	PL	M	0-15	Berwyn	D. GL	M	SiL	0.924	14.9	0.009	1.41	0.085	124	0.009	0.094	0.20	23.6	1.9	23	7.1
590		M	15-30					0.719	3.8	0.004	0.754	0.025	62.2	0.009	0.018	0.30				
590	PL	L	0-15	Berwyn	D. GL	M	L	0.935	10.1	0.004	1.87	0.124	88.6	0.009	0.134	0.20	25.6	2.2	25	6.8
590		L	15-30					0.783	2.8	0.004	0.972	0.023	162	0.008	0.017	0.30				
591	PL	U	0-15	Hamelin	O. DG	L	CL	1.03	4.8	0.004	2.72	0.147	93.9	0.008	0.136	0.50	33.6	3.5	10	6.7
591		U	15-30					0.704	2.0	0.004	0.885	0.050	203	0.007	0.011	0.50				
591	PL	M	0-15	Hamelin	O. DG	L	L	1.67	5.7	0.026	4.19	0.147	49.7	0.007	0.411	0.80	26.6	7.0	13	7.7
591		M	15-30					0.708	18.1	0.046	1.59	0.063	28.3	0.006	0.049	0.30				
591	PL	L	0-15	Northstar	GL. DG	L	CL	2.04	4.6	0.020	5.83	0.360	149	0.008	0.508	0.80	38.6	5.4	33	6.8
591		L	15-30					2.16	10.6	0.004	7.33	0.392	196	0.011	0.634	1.10				
592	PL	U	0-15	glSpirit River	GL. BL	F	L	0.491	22.2	0.080	1.64	0.045	116	0.008	0.274	0.70	23.6	4.6	32	7.7
592		U	15-30					0.119	26.8	0.045	1.20	0.019	46.8	0.007	0.065	0.30				

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
592	PL	M	0-15	glSpirit River	GLE. BL	F	CL	0.557	17.6	0.073	1.79	0.050	127	0.007	0.269	0.80	28.6	4.4	27	7.7
592		M	15-30					0.181	11.4	0.038	1.55	0.021	158	0.007	0.087	0.30				
592	PL	L	0-15	glSpirit River	GL.BL	F	CL	0.678	24.6	0.081	2.13	0.058	139	0.011	0.322	0.80	31.6	5.4	41	7.6
592		L	15-30					0.497	13.4	0.100	2.12	0.051	104	0.011	0.491	1.00				
593	PL	U	0-15	Bluesky	SZ. DG	L	CL	1.51	11.1	0.008	2.60	0.232	256	0.010	0.206	1.00	38.6	4.1	8	7.2
593		U	15-30					2.88	4.0	0.013	1.82	0.124	1970	0.011	0.036	1.50				
593	PL	M	0-15	Bluesky	SZ. DG	L	C	1.22	9.4	0.005	3.33	0.273	147	0.007	0.116	0.80	42.6	3.5	16	8.0
593		M	15-30					1.72	5.2	0.008	3.51	0.071	903	0.007	0.038	0.70				
593	PL	L	0-15	Bluesky	SZ. DG	L	C	0.874	6.2	0.008	2.36	0.388	115	0.009	0.093	0.50	43.6	2.6	17	7.2
593		L	15-30					1.75	9.8	0.008	1.51	0.199	1390	0.005	0.013	0.60				
594	PL	U	0-15	Woking	O. GL	M	CL	0.548	27.1	0.004	1.08	0.162	62.2	0.009	0.057	0.40	37.6	1.3	12	6.0
594		U	15-30					0.631	14.2	0.008	1.22	0.136	80.9	0.008	0.024	0.40				
594	PL	M	0-15	Woking	O. GL	M	CL	0.605	20.9	0.004	1.27	0.165	357	0.010	0.071	0.30	30.6	1.4	12	5.8
594		M	15-30					0.552	6.4	0.008	1.03	0.119	91.5	0.006	0.012	0.60				
594	PL	L	0-15	Donelly	GL. GL	M	CL	0.542	18.7	0.004	1.41	0.238	71.8	0.009	0.079	0.30	31.6	2.4	14	6.5
594		L	15-30					0.498	9.0	0.008	1.05	0.096	144	0.006	0.030	0.30				
595	PL	U	0-15	Dunvegan	O. DG	L	C	1.29	7.4	0.008	2.38	0.205	154	0.009	0.160	1.00	43.6	3.6	38	6.4
595		U	15-30					2.07	7.5	0.02	3.89	0.080	81.1	0.009	0.066	2.30				
595	PL	M	0-15	Dunvegan	O. DG	L	CL	1.10	9.3	0.007	2.59	0.261	125	0.008	0.168	0.80	37.6	3.6	24	6.7
595		M	15-30					1.61	7.2	0.008	1.69	0.128	729	0.010	0.052	0.90				
595	PL	L	0-15	Dunvegan	O. DG	L	CL	0.880	5.6	0.004	2.41	0.330	115	0.008	0.097	0.70	39.6	3.0	23	6.2
595		L	15-30					1.01	9.2	0.008	1.04	0.165	228	0.009	0.015	0.70				
598	PL	U	0-15	Berwyn	D. GL	M	L	0.688	5.6	0.004	1.78	0.103	85.8	0.008	0.130	0.40	23.6	3.6	5	6.3
598		U	15-30					0.500	2.3	0.008	0.858	0.063	94.9	0.009	0.018	0.50				
598	PL	M	0-15	Berwyn	D. GL	M	CL	0.980	5.6	0.004	2.12	0.115	382	0.008	0.153	0.30	29.6	3.5	5	6.1
598		M	15-30					1.35	2.5	0.015	0.961	0.039	1480	0.009	0.031	0.30				
598	PL	L	0-15	Berwyn	D. GL	M	CL	0.960	14.5	0.004	3.47	0.136	279	0.008	0.287	0.30	29.6	3.6	13	6.4
598		L	15-30					0.662	18.4	0.009	2.51	0.073	144	0.007	0.130	0.20				

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
599	PL	U	0-15	Landry	SZ. BL	M	C	1.25	11.1	0.008	3.49	0.364	125	0.008	0.185	1.20	47.6	4.1	11	6.6
599		U	15-30					2.38	8.3	0.011	4.53	0.090	1750	0.009	0.118	1.00				
599	PL	M	0-15	Landry	SZ. BL	M	C	1.68	12.3	0.008	2.03	0.174	858	0.007	0.106	1.40	49.6	4.0	17	6.6
599		M	15-30					2.27	10.6	0.374	3.70	0.073	953	0.005	0.121	1.30				
599	PL	L	0-15	Landry	SZ. BL	M	C	1.46	9.5	0.008	4.04	0.357	357	0.009	0.193	1.60	47.6	3.6	14	6.4
599		L	15-30					2.43	9.4	0.008	4.39	0.054	934	0.008	0.147	1.40				
615	MB	U	0-15	Athabasca	O. GL	M	SiL	1.84	16.9	0.153	0.513	0.041	223	0.010	0.154	0.30	11.6	6.3	120	7.4
615		U	15-30					1.46	7.8	0.110	0.392	0.044	53.2	0.012	0.129	0.40				
615	MB	M	0-15	Athabasca	O. GL	M	L	0.669	3.5	0.004	1.01	0.101	428	0.008	0.080	0.40	17.6	1.9	10	6.1
615		M	15-30					0.856	4.5	0.011	0.900	0.086	546	0.009	0.103	0.40				
615	MB	L	0-15	Bluet	HU. LG	M	L	2.12	9.9	0.044	2.28	0.372	52.6	0.008	0.469	0.80	19.6	5.7	13	7.9
615		L	15-30					1.76	6.3	0.046	1.82	0.153	47.0	0.006	0.225	0.70				
678	BT	U	0-15	Grandin	O. GL	M	SiCL	0.793	11.7	0.004	0.933	0.201	77.4	0.010	0.081	0.50	34.4	2.3	13	5.8
678		U	15-30					0.958	8.9	0.004	0.833	0.107	93.0	0.008	0.032	1.40				
678	BT	M	0-15	Grandin	O. GL	M	SiCL	0.888	15.2	0.004	1.07	0.206	76.1	0.010	0.112	1.10	30.4	2.7	16	5.8
678		M	15-30					0.794	12.9	0.004	1.08	0.121	65.4	0.010	0.083	1.20				
678	BT	L	0-15	Venice	D. GL	M	SiCL	1.49	12.6	0.006	1.85	0.106	108	0.006	0.135	0.80	32.4	6.3	15	6.9
678		L	15-30					1.46	8.7	0.005	1.62	0.066	67.1	0.007	0.092	0.60				
680	BT	U	0-15	Spedden	D. GL	M	L	0.448	9.8	0.004	0.628	0.124	72.5	0.010	0.031	0.30	23.6	1.6	7	6.9
680		U	15-30					0.679	8.0	0.004	0.523	0.057	596	0.007	0.007	0.30				
680	BT	M	0-15	Spedden	D. GL	M	SCL	0.726	5.5	0.004	1.06	0.131	69.9	0.009	0.065	0.30	22.6	2.8	8	6.8
680		M	15-30					0.787	3.6	0.004	1.66	0.046	210	0.008	0.042	0.50				
680	BT	L	0-15	Kehiwin	O. DG	M	L	0.922	8.8	0.004	1.42	0.130	218	0.009	0.088	0.50	20.6	3.5	13	7.0
680		L	15-30					0.927	7.0	0.004	1.21	0.050	207	0.007	0.048	0.50				
681	BT	U	0-15	Uncas	D. GL	FL/M	SL	0.816	7.3	0.004	0.989	0.113	418	0.006	0.054	0.20	20.4	1.92	5	6.7
681		U	15-30					0.514	4.7	0.004	0.822	0.059	50.7	0.007	0.036	0.10				
681	BT	M	0-15	Uncas	D. GL	FL/M	SL	0.508	4.8	0.004	0.984	0.131	53.6	0.008	0.045	0.20	18.4	1.2	5	6.5
681		M	15-30					0.417	3.0	0.006	0.733	0.066	51.2	0.007	0.025	0.10				

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
681	BT	L	0-15	glUncas	GLD. GL	FL/M	SCL	0.910	6.5	0.004	1.38	0.104	207	0.007	0.094	0.30	22.4	2.8	5	6.9
681		L	15-30					0.643	2.3	0.004	1.20	0.067	48.7	0.007	0.055	0.20				
684	BT	U	0-15	Glory	O. GL	FL	L	0.294	6.2	0.014	0.698	0.084	59.1	0.005	0.039	0.20	24.4	0.6	25	5.9
684		U	15-30					0.696	8.2	0.014	0.840	0.049	891	0.006	0.013	0.20				
684	BT	M	0-15	Carvel	D. GL	FL	SiL	0.511	8.2	0.004	1.47	0.147	246	0.008	0.089	0.20	22.4	1.4	26	6.1
684		M	15-30					0.421	6.2	0.004	1.03	0.068	306	0.008	0.030	0.20				
684	BT	L	0-15	glWinterburn	GL. DG	FL	SiL	0.767	13.2	0.020	4.75	0.401	50.5	0.016	0.660	0.20	20.4	2.3	100	6.3
684		L	15-30					0.691	12.2	0.020	1.47	0.105	45.0	0.006	0.198	0.10				
687	BT	U	0-15	Gabriel	D. GL	Fv/M	SL	0.368	14.9	0.008	1.11	0.289	45.8	0.011	0.062	0.10	15.6	1.3	21	6.2
687		U	15-30					0.315	19.5	0.014	0.580	0.058	38.9	0.007	0.014	0.10				
687	BT	M	0-15	Redwater	O. DG	Fv/M	SL	0.510	19.5	0.012	1.19	0.233	47.1	0.013	0.087	0.20	14.6	1.5	30	6.5
687		M	15-30					0.382	10.3	0.013	0.355	0.052	38.9	0.008	0.025	0.10				
687	BT	L	0-15	Egremont	GL. DG	M	L	1.05	21.3	0.024	1.33	0.168	227	0.009	0.086	0.40	19.6	3.2	21	7.5
687		L	15-30					0.874	19.1	0.034	1.28	0.066	41.6	0.009	0.063	0.40				
688	BT	U	0-15	Redwater	O. DG	F	SiL	1.24	2.7	0.010	5.87	0.325	66.6	0.018	0.347	0.40	18.4	0.4	8	6.8
688		U	15-30					0.954	2.4	0.010	1.99	0.073	36.3	0.009	0.057	0.40				
688	BT	M	0-15	Redwater	O. DG	Fb	L	1.26	3.7	0.010	3.42	0.222	202	0.009	0.166	0.40	21.6	5.3	8	6.3
688		M	15-30					0.915	1.4	0.010	4.14	0.134	88.5	0.009	0.100	0.40				
688	BT	L	0-15	Redwater	O. DG	Fb	L	1.16	2.4	0.014	3.77	0.276	89.2	0.011	0.181	0.30	20.6	5.2	21	6.4
688		L	15-30					1.13	2.5	0.016	2.78	0.205	66.5	0.009	0.126	0.20				
692	BT	U	0-15	Maywood	O. GL	L	C	1.23	11.5	0.015	2.25	0.172	89.8	0.012	0.061	0.30	55.6	1.7	9	6.0
692		U	15-30					1.47	8.3	0.015	1.98	0.186	113	0.011	0.016	0.30				
692	BT	M	0-15	Maywood	O. GL	L	C	0.853	6.5	0.011	1.75	0.330	73.8	0.010	0.076	0.40	51.6	4.0	7	5.9
692		M	15-30					1.08	6.8	0.014	1.07	0.155	86.2	0.010	0.036	0.70				
692	BT	L	0-15	glMacola	GLD. GL	L	C	0.838	4.8	0.011	3.33	0.775	79.5	0.013	0.133	0.50	45.6	4.5	5	5.9
692		L	15-30					0.803	4.5	0.008	1.55	0.277	104	0.007	0.050	0.50				
703	BT	U	0-15	Benalto	D. GL	M	SCL	0.371	9.6	0.012	0.784	0.157	90.1	0.011	0.031	0.30	22.6	1.1	5	6.8
703		U	15-30					0.320	7.8	0.012	0.625	0.092	75.4	0.014	0.015	0.30				

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
703	BT	M	0-15	Benalto	D. GL	M	SL	0.322	6.8	0.014	0.626	0.142	110	0.011	0.038	0.20	17.6	1.1	5	6.3
703		M	15-30					0.271	5.5	0.010	0.462	0.076	47.2	0.011	0.016	0.20				
703	BT	L	0-15	Mapova	HU. LG	FL	L	0.714	16.6	0.098	5.00	0.847	23.2	0.011	0.246	1.20	17.6	16.3	25	8.0
703		L	15-30					0.524	2.1	0.038	3.02	0.215	23.1	0.007	0.048	0.30				
727	AP	U	0-15	Angus Ridge	E. BL	M	SiCL	1.32	35.4	0.028	2.58	0.201	81.8	0.012	0.186	0.70	30.4	5.1	33	6.8
727		U	15-30					1.33	32.0	0.034	3.24	0.253	81.0	0.017	0.210	0.70				
727	AP	M	0-15	Angus Ridge	E. BL	M	SiL	1.44	15.2	0.008	3.93	0.397	89.1	0.015	0.268	0.80	20.4	6.3	15	6.0
727		M	15-30					1.42	9.3	0.010	3.43	0.235	86.1	0.013	0.168	0.80				
727	AP	L	0-15	Angus Ridge	E. BL	M	SiL	1.38	74.7	0.013	5.20	0.474	82.9	0.012	0.285	0.60	26.4	5.4	17	6.1
727		L	15-30					1.31	5.0	0.010	5.08	0.419	81.7	0.015	0.195	0.60				
728	AP	U	0-15	Angus Ridge	E. BL	M	SL	0.959	4.6	0.016	0.905	0.150	130	0.011	0.088	0.40	11.6	3.7	20	5.9
728		U	15-30					0.922	5.8	0.022	0.538	0.053	47.9	0.009	0.038	0.50				
728	AP	M	0-15	Beaverhills	O. BL	M	L	1.86	11.2	0.016	2.03	0.219	87.1	0.008	0.145	0.50	15.6	4.9	22	6.2
728		M	15-30					1.90	13.0	0.028	1.31	0.072	69.6	0.013	0.074	0.50				
728	AP	L	0-15	glNorthern Valley	GLE. BL	Fv/M	L	2.32	19.2	0.029	1.81	0.142	86.6	0.009	0.193	0.50	9.6	6.2	57	6.5
728		L	15-30					3.22	16.2	0.070	1.54	0.075	78.0	0.008	0.160	0.40				
730	AP	U	0-15	Elonora	E. BL	M	SCL	0.287	5.8	0.033	1.42	0.081	11.7	0.008	0.054	0.30	23.6	1.5	14	6.9
730		U	15-30					0.322	5.1	0.020	1.26	0.040	18.5	0.008	0.028	0.20				
730	AP	M	0-15	Elonora	E. BL	M	SL	0.645	6.5	0.011	1.34	0.156	296	0.013	0.107	0.40	18.4	2.3	12	6.4
730		M	15-30					0.566	5.0	0.011	0.679	0.064	41.7	0.009	0.031	0.50				
730	AP	L	0-15	glElonora	GLE. BL	M	SL	1.36	4.1	0.034	2.01	0.136	182	0.009	0.179	0.40	14.4	3.4	13	7.0
730		L	15-30					0.778	5.0	0.024	1.43	0.068	235	0.008	0.080	0.20				
738	AP	U	0-15	Elonora	O. BL	M	L	0.801	16.1	0.011	1.76	0.530	68.4	0.013	0.243	0.50	18.6	2.2	31	6.0
738		U	15-30					0.845	14.8	0.013	1.96	0.211	64.8	0.008	0.120	0.40				
738	AP	M	0-15	Elonora	O. BL	M	L	0.755	12.8	0.011	1.65	0.596	109	0.014	0.270	0.50	8.6	3.9	26	6.2
738		M	15-30					0.475	10.1	0.013	1.20	0.204	74.2	0.009	0.108	0.50				
738	AP	L	0-15	Elonora	O. BL	M	L	0.911	11.2	0.011	2.71	0.522	85.6	0.011	0.292	0.60	11.6	5.0	18	7.9

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
738		L	15-30					0.657	10.6	0.010	1.69	0.238	81.5	0.008	0.180	0.40				
739	AP	U	0-15	Irma	O. BL	F	L	0.482	3.5	0.016	2.35	0.332	112	0.008	0.141	0.20	26.4	2.4	18	6.0
739		U	15-30					0.401	2.4	0.030	2.23	0.066	26.5	0.007	0.057	0.20				
739	AP	M	0-15	Irma	O. BL	F	SL	0.428	4.4	0.014	1.79	0.230	45.8	0.010	0.105	0.20	25.4	2.7	11	6.0
739		M	15-30					0.517	3.2	0.014	1.21	0.058	52.9	0.007	0.047	0.10				
739	AP	L	0-15	Irma	O. BL	F	SL	0.574	3.1	0.011	1.84	0.370	66.2	0.012	0.148	0.20	22.4	2.9	8	6.2
739		L	15-30					0.427	2.0	0.014	1.00	0.079	235	0.004	0.048	0.20				
740	AP	U	0-15	Beaverhills	O. BL	M	SL	0.670	12.1	0.013	1.84	0.291	161	0.008	0.083	0.50	15.6	1.1	9	7.0
740		U	15-30					0.599	8.1	0.014	2.11	0.117	45.7	0.007	0.044	0.40				
740	AP	M	0-15	Beaverhills	O. BL	M	SL	1.32	18.6	0.017	2.19	0.410	63.8	0.016	0.172	0.40	15.6	1.4	9	6.8
740		M	15-30					1.42	8.6	0.015	1.85	0.129	39.5	0.008	0.097	0.50				
740	AP	L	0-15	Edburg	GLR. BL	M	L	1.29	10.1	0.144	1.81	0.156	68.4	0.010	0.192	0.80	15.6	1.9	78	6.4
740		L	15-30					1.63	5.1	0.147	1.91	0.092	65.3	0.006	0.133	0.70				
743	AP	U	0-15	Hughenden	CA. DB	M	CL	0.463	2.8	0.042	1.42	0.080	30.2	0.007	0.068	0.40	29.6	1.1	11	7.9
743		U	15-30					0.483	1.2	0.027	1.04	0.069	19.0	0.006	0.027	0.30				
743	AP	M	0-15	Hughenden	CA. DB	M	CL	0.672	4.0	0.012	3.45	0.315	90.8	0.008	0.173	0.60	29.6	1.7	23	6.4
743		M	15-30					0.344	3.4	0.043	2.74	0.114	14.6	0.008	0.115	0.50				
743	AP	L	0-15	Hughenden	O. DB	M	CL	0.620	4.0	0.015	2.60	0.438	408	0.014	0.231	0.70	29.6	2.4	19	5.5
743		L	15-30					0.541	3.7	0.007	1.79	0.234	53.7	0.008	0.146	0.60				
744	AP	U	0-15	Antler	O. BL	M	L	0.817	23.2	0.009	2.43	0.214	70.1	0.010	0.103	0.50	27.6	4.0	7	6.0
744		U	15-30					0.765	31.3	0.010	1.86	0.108	70.3	0.008	0.061	0.40				
744	AP	M	0-15	Cygnnet	E. BL	F/M	L	1.07	15.1	0.010	2.91	0.243	68.4	0.010	0.161	0.50	23.6	3.6	9	6.9
744		M	15-30					0.933	15.3	0.014	2.79	0.102	65.4	0.007	0.074	0.40				
744	AP	L	0-15	glAntler	GL. BL	M	L	1.06	14.9	0.014	4.09	0.254	291	0.009	0.201	0.50	23.6	4.9	13	6.4
744		L	15-30					1.11	14.3	0.014	4.22	0.127	83.9	0.007	0.160	0.50				
746	AP	U	0-15	Antler	O. BL	M	L	0.843	2.5	0.022	2.19	0.127	73.3	0.012	0.190	0.50	27.6	4.4	10	7.2
746		U	15-30					0.550	3.1	0.036	1.64	0.081	61.9	0.007	0.152	0.40				
746	AP	M	0-15	Antler	O. BL	M	L	1.03	4.2	0.016	2.31	0.148	276	0.010	0.238	0.50	23.6	4.9	11	7.0

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
746		M	15-30					1.01	2.8	0.014	1.54	0.085	90.9	0.007	0.116	0.50				
746	AP	L	0-15	Antler	O. BL	M	L	1.49	4.4	0.011	2.44	0.141	112	0.011	0.258	0.60	23.6	6.3	14	6.7
746		L	15-30					1.09	2.1	0.010	2.12	0.182	91.4	0.008	0.149	0.50				
769	MM	U	0-15	Hughenden	O. DB	M	SL	0.720	2.8	0.008	1.71	0.290	165	0.009	0.131	0.40	17.6	2.3	27	5.3
769		U	15-30					0.776	3.4	0.008	1.16	0.147	92.7	0.008	0.072	0.50				
769	MM	M	0-15	Hughenden	O. DB	M	SL	0.740	3.5	0.009	1.43	0.333	94.9	0.015	0.240	0.30	14.6	2.8	28	5.5
769		M	15-30					0.791	4.3	0.011	1.58	0.152	282	0.009	0.223	0.40				
769	MM	L	0-15	Hughenden	O. DB	M	SL	0.837	6.8	0.010	1.60	0.384	145	0.016	0.281	0.30	13.6	3.3	29	5.7
769		L	15-30					0.715	10.3	0.008	1.17	0.246	90.0	0.008	0.131	0.30				
781	MM	U	0-15	Academy	O. BL	M	CL	0.945	11.4	0.007	1.72	0.558	107	0.017	0.189	0.70	30.4	4.1	55	5.6
781		U	15-30					1.01	8.2	0.014	1.44	0.231	109	0.008	0.125	0.80				
781	MM	M	0-15	Academy	O. BL	M	CL	1.01	11.9	0.008	2.48	0.527	109	0.013	0.208	1.10	28.4	4.5	35	6.0
781		M	15-30					0.947	9.8	0.009	2.15	0.226	146	0.015	0.161	0.90				
781	MM	L	0-15	Academy	O. BL	M	L	1.03	15.9	0.008	2.32	0.668	106	0.014	0.168	1.40	26.4	4.4	51	5.6
781		L	15-30					1.01	11.8	0.008	2.05	0.382	89.0	0.014	0.133	1.50				
786	MM	U	0-15	Altario	R. DB	M	SL	0.706	2.5	0.029	1.65	0.051	78.5	0.009	0.052	0.30	14.4	5.5	8	7.1
786		U	15-30					0.396	2.5	0.046	1.88	0.039	62.7	0.008	0.047	0.30				
786	MM	M	0-15	Metisko	O. DB	F/M	SL	0.680	3.2	0.036	1.18	0.041	135	0.009	0.076	0.20	11.4	1.8	12	6.9
786		M	15-30					0.568	2.4	0.032	1.20	0.044	294	0.008	0.065	0.20				
786	MM	L	0-15	Metisko	O. DB	F	SL	0.380	4.1	0.010	0.723	0.089	54.8	0.008	0.093	0.20	10.4	1.7	17	6.5
786		L	15-30					0.361	1.7	0.008	0.573	0.140	53.8	0.008	0.065	0.10				
791	MM	U	0-15	Readymade	O. DB	M	L	0.731	3.0	0.012	2.15	0.189	183	0.009	0.241	0.20	15.6	1.3	37	6.3
791		U	15-30					0.559	2.2	0.016	2.00	0.108	130	0.007	0.092	0.10				
791	MM	M	0-15	Readymade	O. DB	M	L	0.485	4.2	0.086	2.02	0.099	42.6	0.009	0.188	0.30	17.6	2.4	22	6.7
791		M	15-30					0.563	2.8	0.039	1.54	0.042	31.6	0.008	0.072	0.20				
791	MM	L	0-15	Readymade	O. DB	M	L	0.818	5.0	0.022	3.69	0.248	236	0.007	0.466	0.20	19.6	2.6	27	6.1
791		L	15-30					0.618	3.2	0.024	2.97	0.175	526	0.006	0.345	0.30				
793	MM	U	0-15	Readymade	CA. DB	M	L	0.796	3.3	0.057	1.20	0.077	135	0.009	0.179	0.30	19.6	2.4	19	7.2

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	Text-L	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
793		U	15-30					0.530	3.2	0.058	0.888	0.053	39.9	0.007	0.135	0.30				
793	MM	M	0-15	Readymade	O. DB	M	L	0.680	3.1	0.053	1.22	0.125	182	0.009	0.180	0.20	18.6	1.2	18	7.4
793		M	15-30					0.440	3.7	0.032	0.882	0.034	30.3	0.008	0.088	0.30				
793	MM	L	0-15	Readymade	O. DB	M	L	0.873	2.4	0.019	1.55	0.150	126	0.009	0.223	0.30	18.6	1.6	20	6.4
793		L	15-30					0.699	3.2	0.018	1.18	0.066	362	0.007	0.116	0.30				
798	FG	U	0-15	Academy	CA.BL	M	L	1.52	19.1	0.015	1.93	0.146	171	0.008	0.246	0.40	15.6	2.4	18	5.8
798		U	15-30					1.45	14.0	0.029	1.39	0.090	83.8	0.008	0.171	0.50				
798	FG	M	0-15	Delacour	O. BL	M	L	1.98	30.1	0.034	1.39	0.094	75.0	0.009	0.221	0.50	15.6	3.9	17	6.7
798		M	15-30					1.61	22.4	0.031	1.33	0.074	146	0.006	0.149	0.30				
798	FG	L	0-15	Delacour	O. BL	M	L	1.39	17.8	0.016	1.46	0.106	98.2	0.007	0.229	0.50	14.6	4.4	14	6.2
798		L	15-30					0.933	15.3	0.016	1.05	0.118	246	0.009	0.142	0.50				
800	FG	U	0-15	Cardston	O. BL	M	C	1.06	3.3	0.012	4.28	0.318	134	0.008	0.319	0.50	41.6	3.8	15	6.0
800		U	15-30					1.16	5.0	0.014	3.72	0.244	77.8	0.009	0.250	0.50				
800	FG	M	0-15	Cardston	O. BL	M	C	1.06	4.6	0.012	4.40	0.334	279	0.010	0.329	0.50	43.6	2.2	21	6.4
800		M	15-30					1.09	4.2	0.014	4.05	0.280	104	0.010	0.245	0.60				
800	FG	L	0-15	Cardston	O. BL	M	C	1.17	3.2	0.017	4.29	0.287	138	0.008	0.321	0.50	45.6	2.5	24	6.3
800		L	15-30					0.985	8.7	0.031	3.88	0.215	59.1	0.008	0.269	0.60				
804	MG	U	0-15	Purescape	O. DB	M	SL	0.883	3.2	0.015	1.80	0.124	122	0.007	0.081	0.30	18.6	1.4	8	6.5
804		U	15-30					0.778	2.6	0.017	1.55	0.097	215	0.007	0.055	0.30				
804	MG	M	0-15	Purescape	O. DB	M	SL	0.768	4.4	0.038	1.35	0.098	101	0.008	0.054	0.40	18.6	1.3	8	6.7
804		M	15-30					0.675	3.8	0.059	1.15	0.082	124	0.007	0.052	0.40				
804	MG	L	0-15	Ronalaine	SZ. DB	M	L	1.07	3.6	0.048	1.65	0.140	98.6	0.009	0.119	0.50	21.6	2.2	10	6.4
804		L	15-30					0.829	4.2	0.096	1.72	0.105	43.4	0.007	0.099	0.60				
806	MG	U	0-15	Maleb	O.B	M	L	0.666	9.1	0.079	1.59	0.076	39.5	0.008	0.054	0.50	25.6	0.4	14	7.2
806		U	15-30					0.773	10.4	0.083	1.30	0.075	33.1	0.008	0.042	0.50				
806	MG	M	0-15	Maleb	O.B	M	L	0.630	6.7	0.019	1.65	0.184	446	0.007	0.082	0.50	26.6	0.9	14	6.8
806		M	15-30					0.680	6.5	0.029	1.41	0.128	359	0.007	0.068	0.50				
806	MG	L	0-15	Maleb	O.B	M	L	0.715	4.8	0.010	1.26	0.166	221	0.008	0.118	0.50	25.6	1.4	20	6.4

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)² Hot water extractable³ 0.01 M Ca(NO₃)₂ extractable⁴ DTPA extractable⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	Text-PM	ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
806		L	15-30					0.793	8.2	0.013	1.46	0.138	338	0.006	0.096	0.50				
809	MG	U	0-15	Maleb	O.B	M	L	0.739	4.1	0.073	1.12	0.073	63.7	0.009	0.086	0.30	25.6	1.0	9	8.0
809		U	15-30					0.756	2.8	0.076	0.970	0.060	66.6	0.009	0.086	0.30				
809	MG	M	0-15	Maleb	O.B	M	L	0.886	10.2	0.023	1.98	0.135	140	0.027	0.078	0.40	23.6	1.0	7	7.5
809		M	15-30					0.682	3.0	0.056	1.82	0.085	34.9	0.007	0.082	0.30				
809	MG	L	0-15	Maleb	O.B	M	L	0.706	14.2	0.021	1.16	0.095	153	0.008	0.121	0.30	27.6	1.4	10	7.3
809		L	15-30					0.628	3.5	0.019	1.24	0.078	198	0.007	0.073	0.30				
812	MG	U	0-15	Travers	CA. B	M	L	0.604	10.9	0.109	1.23	0.106	39.1	0.007	0.034	0.30	27.6	0.8	12	8.1
812		U	15-30					0.713	7.9	0.125	1.28	0.109	50.3	0.007	0.036	0.30				
812	MG	M	0-15	Travers	CA. B	M	SCL	0.685	8.7	0.106	1.25	0.080	42.0	0.006	0.033	0.20	23.6	0.4	13	8.3
812		M	15-30					0.657	9.5	0.106	1.27	0.091	37.4	0.007	0.030	0.30				
812	MG	L	0-15	Travers	CA. B	M	CL	0.754	12.6	0.116	1.44	0.102	49.4	0.008	0.048	0.40	31.6	0.8	28	8.2
812		L	15-30					0.788	12.1	0.117	1.51	0.097	45.9	0.009	0.047	0.30				
815	MG	U	0-15	Travers	CA. B	M	SCL	0.814	4.9	0.050	0.872	0.070	79.9	0.008	0.070	0.40	22.6	0.8	12	8.2
815		U	15-30					0.628	4.4	0.036	0.678	0.041	44.5	0.008	0.037	0.30				
815	MG	M	0-15	Travers	CA. B	M	SL	0.746	3.2	0.050	0.829	0.073	108	0.009	0.065	0.30	17.6	0.9	14	8.2
815		M	15-30					0.571	3.8	0.035	1.51	0.062	49.2	0.009	0.051	0.30				
815	MG	L	0-15	Maleb	E. B	M	L	0.948	3.6	0.037	2.57	0.211	139	0.008	0.330	0.40	25.6	1.3	46	6.4
815		L	15-30					0.727	2.7	0.038	1.55	0.118	282	0.006	0.157	0.40				
823	MG	U	0-15	Antonio	CA. B	FL/M	CL	0.605	14.8	0.074	1.38	0.133	86.5	0.011	0.092	0.20	30.6	1.1	31	8.0
823		U	15-30					0.559	24.7	0.078	1.20	0.113	67.2	0.009	0.076	0.30				
823	MG	M	0-15	Antonio	O. B	FL/M	L	0.666	23.0	0.080	1.21	0.156	139	0.010	0.148	0.30	25.6	1.1	36	7.3
823		M	15-30					0.770	17.1	0.064	1.14	0.125	245	0.009	0.131	0.20				
823	MG	L	0-15	Antonio	O. B	FL/M	L	0.721	25.2	0.066	1.26	0.136	260	0.011	0.174	0.30	24.6	1.1	28	7.3
823		L	15-30					0.822	31.1	0.059	1.19	0.133	137	0.009	0.171	0.30				
1828	MG	U	0-15	Helmsdale	R. B	M	L	0.630	2.7	0.037	0.687	0.055	61.2	0.008	0.037	0.20	21.6	0.8	8	8.2
1828		U	15-30					0.502	1.4	0.039	0.637	0.042	41.2	0.008	0.026	0.20				
1828	MG	M	0-15	Maleb	O. B	M	L	0.788	19.2	0.052	1.17	0.139	173	0.009	0.152	0.20	21.6	0.7	24	6.9

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 1. Micronutrient and selected soil properties of the 0-15 cm and 15-30 cm depths for 43 benchmark sites (continued).

Site #	Eco-Region ¹	Slope Pos	Depth (cm)	Soil Series	Soil Subgrp	PM	Text-ure	B ² (mg/kg)	Cl ³ (mg/kg)	Mo ² (mg/kg)	Ni ⁴ (mg/kg)	Co ⁴ (mg/kg)	Si ² (mg/kg)	Cr ⁴ (mg/kg)	Cd ⁴ (mg/kg)	Se ⁵ (mg/kg)	Clay (%)	OC (%)	P (kg/ha)	pHw
1828		M	15-30					0.811	6.2	0.026	1.48	0.110	147	0.008	0.057	0.30				
1828	MG	L	0-15	Maleb	O. B	M	L	0.863	6.5	0.042	1.11	0.128	179	0.009	0.103	0.30	21.6	0.7	13	7.9
1828		L	15-30					0.702	1.6	0.026	1.40	0.136	150	0.008	0.077	0.30				
2828	MG	U	0-15	Maleb	O. B	M	CL	0.546	5.5	0.021	1.83	0.216	185	0.008	0.109	0.30	28.4	1.1	15	5.8
2828		U	15-30					0.347	3.1	0.029	2.12	0.088	26.2	0.007	0.069	0.30				
2828	MG	M	0-15	Maleb	O. B	M	L	0.480	6.0	0.021	1.69	0.218	113	0.009	0.138	0.40	22.4	1.0	21	6.4
2828		M	15-30					0.495	5.0	0.022	2.22	0.178	124	0.008	0.094	0.40				
2828	MG	L	0-15	Maleb	O. B	M	L	0.547	9.9	0.028	1.94	0.226	108	0.008	0.146	0.40	24.4	1.1	26	6.3
2828		L	15-30					0.235	5.7	0.031	2.36	0.165	24.6	0.008	0.083	0.30				

¹ Ecoregions- PL (Peace Lowlands); MB (Mixed Boreal Uplands); BT (Boreal Transition); AP (Aspen Parkland); MM (Mixed Moist Grassland); FG (Fescue Grassland); and MG (Mixed Grassland)

² Hot water extractable

³ 0.01 M Ca(NO₃)₂ extractable

⁴ DTPA extractable

⁵ Total

Appendix 2. Descriptive statistics (mean, min, max and standard deviation) for selected micronutrients and trace elements of upper, mid and lower slope positions in seven ecoregions.

Ecoregion	No. of Sites	Statistic	Sample Depth (cm)	Slope Position	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
PL	10	Mean	0-15	U	0.95	12.25	0.023	1.93	0.140	109.2	0.008	0.152	0.65
PL	10	Mean	0-15	M	1.14	11.61	0.022	2.13	0.135	243.8	0.008	0.174	0.68
PL	10	Mean	0-15	L	1.07	10.75	0.016	2.63	0.213	147.3	0.009	0.194	0.62
ecoreg mean					1.05	11.54	0.02	2.23	0.16	166.78	0.008	0.17	0.65
PL	10	Mean	15-30	U	1.25	9.39	0.016	1.68	0.081	487.7	0.009	0.038	0.82
PL	10	Mean	15-30	M	1.20	8.20	0.053	1.86	0.067	455.1	0.008	0.054	0.57
PL	10	Mean	15-30	L	1.21	12.04	0.017	2.37	0.125	344.1	0.008	0.167	0.68
ecoreg mean					1.22	9.88	0.03	1.97	0.09	428.95	0.008	0.09	0.69
PL	10	Min	0-15	U	0.48	2.20	0.004	0.75	0.040	41.0	0.007	0.026	0.20
PL	10	Min	0-15	M	0.56	4.60	0.004	0.65	0.034	49.7	0.007	0.052	0.20
PL	10	Min	0-15	L	0.54	3.90	0.004	1.04	0.058	71.8	0.006	0.056	0.20
PL	10	Min	15-30	U	0.12	2.00	0.004	0.37	0.019	30.3	0.007	0.004	0.30
PL	10	Min	15-30	M	0.18	2.50	0.004	0.75	0.021	28.3	0.005	0.012	0.30
PL	10	Min	15-30	L	0.50	2.80	0.004	0.97	0.023	68.5	0.005	0.013	0.20
PL	10	Max	0-15	U	1.51	27.10	0.080	3.49	0.364	256.0	0.010	0.288	1.20
PL	10	Max	0-15	M	1.68	20.90	0.073	4.19	0.273	858.0	0.010	0.411	1.40
PL	10	Max	0-15	L	2.04	24.60	0.081	5.83	0.388	357.0	0.011	0.508	1.60
PL	10	Max	15-30	U	2.88	26.80	0.045	4.53	0.169	1970.0	0.011	0.118	2.30
PL	10	Max	15-30	M	2.27	18.10	0.374	3.70	0.128	1480.0	0.010	0.121	1.30
PL	10	Max	15-30	L	2.43	21.20	0.100	7.33	0.392	1390.0	0.011	0.634	1.40
PL	10	Std. Dev.	0-15	U	0.37	8.14	0.027	0.89	0.105	60.9	0.001	0.089	0.33
PL	10	Std. Dev.	0-15	M	0.41	5.59	0.024	1.03	0.085	242.6	0.001	0.116	0.38
PL	10	Std. Dev.	0-15	L	0.43	6.70	0.024	1.44	0.136	95.4	0.001	0.141	0.41
ecoreg mean					0.40	6.81	0.02	1.12	0.11	132.95	0.001	0.12	0.37
PL	10	Std. Dev.	15-30	U	0.91	8.07	0.012	1.39	0.049	743.4	0.002	0.035	0.66
PL	10	Std. Dev.	15-30	M	0.64	4.94	0.113	1.03	0.039	518.9	0.002	0.036	0.34
PL	10	Std. Dev.	15-30	L	0.69	5.41	0.029	2.03	0.109	447.1	0.002	0.217	0.41
ecoreg mean					0.75	6.14	0.05	1.48	0.07	569.82	0.002	0.10	0.47
MB	1	Mean	0-15	U	1.84	16.90	0.153	0.51	0.041	223.0	0.010	0.154	0.30
MB	1	Mean	0-15	M	0.67	3.50	0.004	1.01	0.101	428.0	0.008	0.080	0.40
MB	1	Mean	0-15	L	2.12	9.90	0.044	2.28	0.372	52.6	0.008	0.469	0.80
MB	1	Mean	15-30	U	1.46	7.80	0.110	0.39	0.044	53.2	0.012	0.129	0.40
MB	1	Mean	15-30	M	0.86	4.50	0.011	0.90	0.086	546.0	0.009	0.103	0.40
MB	1	Mean	15-30	L	1.76	6.30	0.046	1.82	0.153	47.0	0.006	0.225	0.70

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

Appendix 2. Descriptive statistics (mean, min, max and standard deviation) for selected micronutrients and trace elements of upper, mid and lower slope positions in seven ecoregions (continued).

Ecoregion	No. of Sites	Statistic	Sample Depth (cm)	Slope Position	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
BT	8	Mean	0-15	U	0.70	9.21	0.009	1.66	0.183	114.9	0.010	0.088	0.29
BT	8	Mean	0-15	M	0.70	8.78	0.008	1.45	0.193	109.8	0.010	0.085	0.38
BT	8	Mean	0-15	L	0.98	10.78	0.023	2.85	0.351	125.3	0.010	0.203	0.53
				ecoreg mean	0.79	9.59	0.01	1.99	0.24	116.68	0.010	0.13	0.40
BT	8	Mean	15-30	U	0.74	8.48	0.010	1.02	0.085	236.8	0.009	0.024	0.39
BT	8	Mean	15-30	M	0.63	6.21	0.008	1.32	0.090	111.7	0.009	0.045	0.43
BT	8	Mean	15-30	L	0.88	7.30	0.016	1.77	0.131	75.4	0.007	0.085	0.35
				ecoreg mean	0.75	7.33	0.01	1.37	0.10	141.28	0.008	0.05	0.39
BT	8	Min	0-15	U	0.29	2.70	0.004	0.63	0.084	45.8	0.005	0.031	0.10
BT	8	Min	0-15	M	0.32	3.70	0.004	0.63	0.131	47.1	0.008	0.038	0.20
BT	8	Min	0-15	L	0.71	2.40	0.004	1.33	0.104	23.2	0.006	0.086	0.20
BT	8	Min	15-30	U	0.32	2.40	0.004	0.52	0.049	36.3	0.006	0.007	0.10
BT	8	Min	15-30	M	0.27	1.40	0.004	0.36	0.046	38.9	0.007	0.016	0.10
BT	8	Min	15-30	L	0.52	2.10	0.004	1.20	0.050	23.1	0.006	0.048	0.10
BT	8	Max	0-15	U	1.24	14.90	0.015	5.87	0.325	418.0	0.018	0.347	0.50
BT	8	Max	0-15	M	1.26	19.50	0.014	3.42	0.330	246.0	0.013	0.166	1.10
BT	8	Max	0-15	L	1.49	21.30	0.098	5.00	0.847	227.0	0.016	0.660	1.20
BT	8	Max	15-30	U	1.47	19.50	0.015	1.99	0.186	891.0	0.014	0.057	1.40
BT	8	Max	15-30	M	1.08	12.90	0.014	4.14	0.155	306.0	0.011	0.100	1.20
BT	8	Max	15-30	L	1.46	19.10	0.038	3.02	0.277	207.0	0.009	0.198	0.60
		Std.											
BT	8	Dev.	0-15	U	0.39	3.77	0.005	1.78	0.085	123.4	0.004	0.106	0.12
BT	8	Dev.	0-15	M	0.30	5.58	0.004	0.86	0.069	73.8	0.002	0.041	0.31
BT	8	Dev.	0-15	L	0.25	6.35	0.031	1.55	0.302	80.5	0.003	0.193	0.33
				ecoreg mean	0.312	5.232	0.013	1.397	0.152	92.560	0.003	0.113	0.253
		Std.											
BT	8	Dev.	15-30	U	0.39	4.98	0.005	0.61	0.045	323.6	0.003	0.017	0.42
BT	8	Dev.	15-30	M	0.30	3.83	0.004	1.21	0.041	95.5	0.001	0.030	0.38
BT	8	Dev.	15-30	L	0.30	5.95	0.014	0.72	0.088	58.3	0.001	0.053	0.18
				ecoreg mean	0.327	4.921	0.008	0.846	0.058	159.145	0.002	0.033	0.326

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

Appendix 2. Descriptive statistics (mean, min, max and standard deviation) for selected micronutrients and trace elements of upper, mid and lower slope positions in seven ecoregions (continued).

Ecoregion	No. of Sites	Statistic	Sample Depth (cm)	Slope Position	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
AP	9	Mean	0-15	U	0.74	11.78	0.021	1.88	0.223	82.1	0.010	0.128	0.44
AP	9	Mean	0-15	M	1.02	10.22	0.013	2.40	0.302	125.1	0.012	0.182	0.49
AP	9	Mean	0-15	L	1.22	16.19	0.031	2.72	0.293	153.6	0.011	0.220	0.54
ecoreg mean					1.00	12.73	0.02	2.33	0.27	120.27	0.011	0.18	0.49
AP	9	Mean	15-30	U	0.69	11.53	0.023	1.76	0.111	48.4	0.009	0.082	0.39
AP	9	Mean	15-30	M	0.95	7.86	0.018	1.86	0.118	59.4	0.009	0.092	0.48
AP	9	Mean	15-30	L	1.20	7.11	0.034	2.31	0.168	111.7	0.008	0.139	0.46
ecoreg mean					0.95	8.83	0.02	1.98	0.13	73.19	0.009	0.10	0.44
AP	9	Min	0-15	U	0.29	2.50	0.009	0.91	0.080	11.7	0.007	0.054	0.20
AP	9	Min	0-15	M	0.43	4.00	0.008	1.34	0.148	45.8	0.008	0.105	0.20
AP	9	Min	0-15	L	0.57	3.10	0.011	1.81	0.136	66.2	0.009	0.148	0.20
AP	9	Min	15-30	U	0.32	1.20	0.010	0.54	0.040	18.5	0.006	0.027	0.20
AP	9	Min	15-30	M	0.34	2.80	0.010	0.68	0.058	14.6	0.007	0.031	0.10
AP	9	Min	15-30	L	0.43	2.00	0.007	1.00	0.068	53.7	0.004	0.048	0.20
AP	9	Max	0-15	U	1.32	35.40	0.042	2.58	0.530	161.0	0.013	0.243	0.70
AP	9	Max	0-15	M	1.86	18.60	0.017	3.93	0.596	296.0	0.016	0.270	0.80
AP	9	Max	0-15	L	2.32	74.70	0.144	5.20	0.522	408.0	0.014	0.292	0.80
AP	9	Max	15-30	U	1.33	32.00	0.036	3.24	0.253	81.0	0.017	0.210	0.70
AP	9	Max	15-30	M	1.90	15.30	0.043	3.43	0.235	90.9	0.013	0.168	0.80
AP	9	Max	15-30	L	3.22	16.20	0.147	5.08	0.419	235.0	0.015	0.195	0.70
AP	9	Std. Dev.	0-15	U	0.31	11.35	0.011	0.56	0.144	46.7	0.002	0.065	0.14
AP	9	Std. Dev.	0-15	M	0.46	5.58	0.003	0.86	0.145	93.1	0.003	0.063	0.16
AP	9	Std. Dev.	0-15	L	0.53	22.64	0.043	1.18	0.159	120.0	0.002	0.050	0.17
ecoreg mean					0.43	13.19	0.02	0.87	0.15	86.62	0.002	0.06	0.16
AP	9	Std. Dev.	15-30	U	0.31	12.08	0.009	0.78	0.074	23.0	0.003	0.064	0.15
AP	9	Std. Dev.	15-30	M	0.53	4.54	0.011	0.92	0.062	24.6	0.002	0.041	0.18
AP	9	Std. Dev.	15-30	L	0.85	5.27	0.047	1.38	0.115	70.8	0.003	0.047	0.17
ecoreg mean					0.57	7.30	0.02	1.03	0.08	39.44	0.003	0.05	0.17

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

Appendix 2. Descriptive statistics (mean, min, max and standard deviation) for selected micronutrients and trace elements of upper, mid and lower slope positions in seven ecoregions (continued).

Ecoregion	No. of Sites	Statistic	Sample Depth (cm)	Slope Position	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
MM	5	Mean	0-15	U	0.78	4.60	0.023	1.69	0.233	133.7	0.011	0.158	0.38
MM	5	Mean	0-15	M	0.72	5.18	0.038	1.67	0.225	112.7	0.011	0.178	0.42
MM	5	Mean	0-15	L	0.79	6.84	0.014	1.98	0.308	133.6	0.011	0.246	0.48
				ecoreg mean	0.76	5.54	0.02	1.78	0.26	126.65	0.011	0.19	0.43
MM	5	Mean	15-30	U	0.65	3.90	0.028	1.47	0.116	86.9	0.008	0.094	0.40
MM	5	Mean	15-30	M	0.66	4.60	0.025	1.47	0.100	156.8	0.010	0.122	0.40
MM	5	Mean	15-30	L	0.68	6.04	0.013	1.59	0.202	224.2	0.009	0.158	0.50
				ecoreg mean	0.67	4.85	0.02	1.51	0.14	155.93	0.009	0.12	0.43
MM	5	Min	0-15	U	0.71	2.50	0.007	1.20	0.051	78.5	0.009	0.052	0.20
MM	5	Min	0-15	M	0.49	3.10	0.008	1.18	0.041	42.6	0.009	0.076	0.20
MM	5	Min	0-15	L	0.38	2.40	0.008	0.72	0.089	54.8	0.007	0.093	0.20
MM	5	Min	15-30	U	0.40	2.20	0.008	0.89	0.039	39.9	0.007	0.047	0.10
MM	5	Min	15-30	M	0.44	2.40	0.009	0.88	0.034	30.3	0.008	0.065	0.20
MM	5	Min	15-30	L	0.36	1.70	0.008	0.57	0.066	53.8	0.006	0.065	0.10
MM	5	Max	0-15	U	0.95	11.40	0.057	2.15	0.558	183.0	0.017	0.241	0.70
MM	5	Max	0-15	M	1.01	11.90	0.086	2.48	0.527	182.0	0.015	0.240	1.10
MM	5	Max	0-15	L	1.03	15.90	0.022	3.69	0.668	236.0	0.016	0.466	1.40
MM	5	Max	15-30	U	1.01	8.20	0.058	2.00	0.231	130.0	0.008	0.135	0.80
MM	5	Max	15-30	M	0.95	9.80	0.039	2.15	0.226	294.0	0.015	0.223	0.90
MM	5	Max	15-30	L	1.01	11.80	0.024	2.97	0.382	526.0	0.014	0.345	1.50
MM	5	Std. Dev.	0-15	U	0.10	3.81	0.021	0.34	0.205	42.3	0.004	0.071	0.19
MM	5	Std. Dev.	0-15	M	0.19	3.78	0.033	0.57	0.202	51.3	0.003	0.062	0.38
MM	5	Std. Dev.	0-15	L	0.24	5.31	0.006	1.11	0.230	66.4	0.004	0.141	0.52
				ecoreg mean	0.18	4.30	0.02	0.67	0.21	53.37	0.003	0.09	0.36
MM	5	Std. Dev.	15-30	U	0.24	2.45	0.022	0.47	0.078	36.0	0.001	0.037	0.26
MM	5	Std. Dev.	15-30	M	0.20	3.00	0.014	0.47	0.086	128.7	0.003	0.068	0.29
MM	5	Std. Dev.	15-30	L	0.23	4.64	0.007	0.93	0.120	209.4	0.003	0.108	0.57
				ecoreg mean	0.23	3.37	0.01	0.63	0.09	124.70	0.002	0.07	0.37

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

Appendix 2. Descriptive statistics (mean, min, max and standard deviation) for selected micronutrients and trace elements of upper, mid and lower slope positions in seven ecoregions (continued).

Ecoregion	No. of Sites	Statistic	Sample Depth (cm)	Slope Position	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
FG	2	Mean	0-15	U	1.29	11.20	0.014	3.11	0.232	152.5	0.008	0.283	0.45
FG	2	Mean	0-15	M	1.52	17.35	0.023	2.90	0.214	177.0	0.010	0.275	0.50
FG	2	Mean	0-15	L	1.28	10.50	0.017	2.88	0.197	118.1	0.008	0.275	0.50
				ecoreg mean	1.36	13.02	0.02	2.96	0.21	149.20	0.008	0.28	0.48
FG	2	Mean	15-30	U	1.31	9.50	0.022	2.56	0.167	80.8	0.009	0.211	0.50
FG	2	Mean	15-30	M	1.35	13.30	0.023	2.69	0.177	125.0	0.008	0.197	0.45
FG	2	Mean	15-30	L	0.96	12.00	0.024	2.47	0.167	152.6	0.009	0.206	0.55
				ecoreg mean	1.20	11.60	0.02	2.57	0.17	119.45	0.008	0.20	0.50
FG	2	Min	0-15	U	1.06	3.30	0.012	1.93	0.146	134.0	0.008	0.246	0.40
FG	2	Min	0-15	M	1.06	4.60	0.012	1.39	0.094	75.0	0.009	0.221	0.50
FG	2	Min	0-15	L	1.17	3.20	0.016	1.46	0.106	98.2	0.007	0.229	0.50
FG	2	Min	15-30	U	1.16	5.00	0.014	1.39	0.090	77.8	0.008	0.171	0.50
FG	2	Min	15-30	M	1.09	4.20	0.014	1.33	0.074	104.0	0.006	0.149	0.30
FG	2	Min	15-30	L	0.93	8.70	0.016	1.05	0.118	59.1	0.008	0.142	0.50
FG	2	Max	0-15	U	1.52	19.10	0.015	4.28	0.318	171.0	0.008	0.319	0.50
FG	2	Max	0-15	M	1.98	30.10	0.034	4.40	0.334	279.0	0.010	0.329	0.50
FG	2	Max	0-15	L	1.39	17.80	0.017	4.29	0.287	138.0	0.008	0.321	0.50
FG	2	Max	15-30	U	1.45	14.00	0.029	3.72	0.244	83.8	0.009	0.250	0.50
FG	2	Max	15-30	M	1.61	22.40	0.031	4.05	0.280	146.0	0.010	0.245	0.60
FG	2	Max	15-30	L	0.99	15.30	0.031	3.88	0.215	246.0	0.009	0.269	0.60
FG	2	Std. Dev.	0-15	U	0.33	11.17	0.002	1.66	0.122	26.2	0.000	0.052	0.07
FG	2	Std. Dev.	0-15	M	0.65	18.03	0.016	2.13	0.170	144.2	0.001	0.076	0.00
FG	2	Std. Dev.	0-15	L	0.16	10.32	0.001	2.00	0.128	28.1	0.001	0.065	0.00
				ecoreg mean	0.38	13.18	0.01	1.93	0.14	66.19	0.0005	0.06	0.02
FG	2	Std. Dev.	15-30	U	0.21	6.36	0.011	1.65	0.109	4.2	0.001	0.056	0.00
FG	2	Std. Dev.	15-30	M	0.37	12.87	0.012	1.92	0.146	29.7	0.003	0.068	0.21
FG	2	Std. Dev.	15-30	L	0.04	4.67	0.011	2.00	0.069	132.2	0.001	0.090	0.07
				ecoreg mean	0.20	7.97	0.01	1.86	0.11	55.37	0.001	0.07	0.09

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

Appendix 2. Descriptive statistics (mean, min, max and standard deviation) for selected micronutrients and trace elements of upper, mid and lower slope positions in seven ecoregions (continued).

Ecoregion	No. of Sites	Statistic	Sample Depth (cm)	Slope Position	B ¹ (mg/kg)	Cl ² (mg/kg)	Mo ¹ (mg/kg)	Ni ³ (mg/kg)	Co ³ (mg/kg)	Si ¹ (mg/kg)	Cr ³ (mg/kg)	Cd ³ (mg/kg)	Se ⁴ (mg/kg)
MG	8	Mean	0-15	U	0.69	6.90	0.057	1.31	0.107	84.6	0.008	0.070	0.31
MG	8	Mean	0-15	M	0.71	10.18	0.049	1.39	0.135	157.8	0.011	0.094	0.34
MG	8	Mean	0-15	L	0.79	10.05	0.046	1.55	0.151	151.0	0.009	0.145	0.39
				ecoreg mean	0.73	9.04	0.05	1.42	0.13	131.12	0.009	0.10	0.35
MG	8	Mean	15-30	U	0.63	7.16	0.060	1.22	0.078	68.0	0.008	0.053	0.31
MG	8	Mean	15-30	M	0.67	6.86	0.050	1.50	0.108	140.1	0.008	0.071	0.34
MG	8	Mean	15-30	L	0.69	8.64	0.050	1.55	0.121	152.4	0.008	0.100	0.38
				ecoreg mean	0.66	7.55	0.05	1.42	0.10	120.15	0.008	0.07	0.34
MG	8	Min	0-15	U	0.55	2.70	0.015	0.69	0.055	39.1	0.007	0.034	0.20
MG	8	Min	0-15	M	0.48	3.20	0.019	0.83	0.073	42.0	0.006	0.033	0.20
MG	8	Min	0-15	L	0.55	3.60	0.010	1.11	0.095	49.4	0.008	0.048	0.30
MG	8	Min	15-30	U	0.35	1.40	0.017	0.64	0.041	26.2	0.007	0.026	0.20
MG	8	Min	15-30	M	0.50	3.00	0.022	1.14	0.062	34.9	0.007	0.030	0.20
MG	8	Min	15-30	L	0.24	1.60	0.013	1.19	0.078	24.6	0.006	0.047	0.30
MG	8	Max	0-15	U	0.88	14.80	0.109	1.83	0.216	185.0	0.011	0.109	0.50
MG	8	Max	0-15	M	0.89	23.00	0.106	1.98	0.218	446.0	0.027	0.152	0.50
MG	8	Max	0-15	L	1.07	25.20	0.116	2.57	0.226	260.0	0.011	0.330	0.50
MG	8	Max	15-30	U	0.78	24.70	0.125	2.12	0.113	215.0	0.009	0.086	0.50
MG	8	Max	15-30	M	0.81	17.10	0.106	2.22	0.178	359.0	0.009	0.131	0.50
MG	8	Max	15-30	L	0.83	31.10	0.117	2.36	0.165	338.0	0.009	0.171	0.60
MG	8	Std. Dev.	0-15	U	0.12	4.28	0.032	0.42	0.052	48.7	0.001	0.027	0.10
MG	8	Std. Dev.	0-15	M	0.12	7.17	0.031	0.36	0.051	122.5	0.007	0.046	0.11
MG	8	Std. Dev.	0-15	L	0.16	7.34	0.033	0.50	0.048	68.3	0.001	0.083	0.08
				ecoreg mean	0.13	6.26	0.03	0.43	0.05	79.83	0.003	0.05	0.10
MG	8	Std. Dev.	15-30	U	0.15	7.71	0.036	0.48	0.028	61.1	0.001	0.022	0.08
MG	8	Std. Dev.	15-30	M	0.10	4.62	0.028	0.37	0.036	113.0	0.001	0.031	0.09
MG	8	Std. Dev.	15-30	L	0.20	9.68	0.038	0.37	0.027	115.3	0.001	0.043	0.12
				ecoreg mean	0.15	7.34	0.03	0.40	0.03	96.49	0.001	0.03	0.10

¹ Hot water extractable

² 0.01 M Ca(NO₃)₂ extractable

³ DTPA extractable

⁴ Total

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth).

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
586	PL	U	0-15	11.70	0.91	0.01	0.06	2.87	0.001	0.02	0.185	0.288	0.007	0.060	0.889
586	PL	M	0-15	15.80	0.81	0.01	0.07	1.81	0.001	0.02	0.255	0.298	0.007	0.049	1.260
586	PL	L	0-15	9.80	1.34	0.01	0.07	1.41	0.001	0.03	0.198	0.170	0.006	0.076	1.270
588	PL	U	0-15	19.30	0.02	0.01	0.06	1.51	0.001	0.02	0.244	0.026	0.007	0.040	1.980
588	PL	M	0-15	4.60	0.02	0.01	0.06	1.11	0.001	0.01	0.373	0.052	0.009	0.034	1.520
588	PL	L	0-15	3.90	0.02	0.01	0.04	1.02	0.001	0.03	0.219	0.056	0.008	0.060	4.810
590	PL	U	0-15	2.20	0.02	0.01	0.03	1.11	0.001	0.02	0.341	0.061	0.009	0.041	1.190
590	PL	M	0-15	14.90	4.08	0.01	0.05	3.10	0.001	0.01	0.149	0.094	0.009	0.085	0.604
590	PL	L	0-15	10.10	11.30	0.01	0.06	3.45	0.001	0.01	0.198	0.134	0.009	0.124	0.567
591	PL	U	0-15	4.80	5.66	0.01	0.08	2.42	0.001	0.02	0.175	0.136	0.008	0.147	1.550
591	PL	M	0-15	5.70	0.07	0.01	0.10	3.70	0.001	0.01	0.385	0.411	0.007	0.147	1.510
591	PL	L	0-15	4.60	0.88	0.02	0.07	3.64	0.002	0.06	0.251	0.508	0.008	0.360	2.130
592	PL	U	0-15	22.20	0.02	0.01	0.06	3.23	0.001	0.03	0.200	0.274	0.008	0.045	1.090
592	PL	M	0-15	17.60	0.02	0.01	0.07	3.62	0.001	0.02	0.140	0.269	0.007	0.050	1.210
592	PL	L	0-15	24.60	0.03	0.02	0.08	3.51	0.002	0.04	0.136	0.322	0.011	0.058	1.200
593	PL	U	0-15	11.10	12.40	0.01	0.13	1.65	0.001	0.01	0.160	0.206	0.010	0.232	1.350
593	PL	M	0-15	9.40	1.43	0.01	0.11	2.13	0.001	0.02	0.214	0.116	0.007	0.273	2.130
593	PL	L	0-15	6.20	1.00	0.01	0.13	1.97	0.001	0.01	1.090	0.093	0.009	0.388	2.180
594	PL	U	0-15	27.10	31.90	0.01	0.07	0.95	0.001	0.01	0.547	0.057	0.009	0.162	1.320
594	PL	M	0-15	20.90	25.60	0.01	0.05	1.46	0.001	0.01	0.899	0.071	0.010	0.165	1.070
594	PL	L	0-15	18.70	13.80	0.01	0.06	1.38	0.001	0.01	1.150	0.079	0.009	0.238	1.130
595	PL	U	0-15	7.40	32.80	0.01	0.15	0.99	0.001	0.01	0.920	0.160	0.009	0.205	1.590
595	PL	M	0-15	9.30	41.50	0.01	0.12	1.09	0.001	0.01	1.270	0.168	0.008	0.261	1.030
595	PL	L	0-15	5.60	31.40	0.01	0.09	1.06	0.001	0.01	1.270	0.097	0.008	0.330	1.140
599	PL	U	0-15	11.10	19.70	0.02	0.19	1.48	0.002	0.03	1.570	0.185	0.008	0.364	2.160
599	PL	M	0-15	12.30	18.90	0.01	0.07	0.82	0.001	0.01	1.110	0.106	0.007	0.174	1.240
599	PL	L	0-15	9.50	19.50	0.02	0.16	1.30	0.002	0.03	1.670	0.193	0.009	0.357	2.240
			Mean	11.87	10.19	0.01	0.08	1.99	0.001	0.02	0.57	0.17	0.01	0.17	1.53
			Max	27.10	41.50	0.02	0.19	3.70	0.002	0.06	1.67	0.51	0.01	0.39	4.81
			Min	2.20	0.02	0.01	0.03	0.82	0.001	0.01	0.14	0.03	0.01	0.03	0.57
			SD	6.82	12.87	0.00	0.04	1.00	0.000	0.01	0.50	0.12	0.00	0.12	0.80
			CV (%)	57.51	126.30	31.53	46.06	50.39	31.53	62.65	87.71	69.13	14.08	70.51	52.47

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
615	MB	U	0-15	16.90	0.98	0.01	0.03	1.59	0.001	0.01	1.710	0.154	0.010	0.041	1.260
615	MB	M	0-15	3.50	9.72	0.01	0.04	2.02	0.001	0.01	1.200	0.080	0.008	0.101	0.609
615	MB	L	0-15	9.90	0.35	0.05	0.10	4.09	0.005	0.07	3.450	0.469	0.008	0.372	1.570
			Mean	10.10	3.68	0.02	0.06	2.57	0.002	0.03	2.12	0.23	0.01	0.17	1.15
			Max	16.90	9.72	0.05	0.10	4.09	0.005	0.07	3.45	0.47	0.01	0.37	1.57
			Min	3.50	0.35	0.01	0.03	1.59	0.001	0.01	1.20	0.08	0.01	0.04	0.61
			SD	6.70	5.24	0.02	0.04	1.34	0.002	0.03	1.18	0.21	0.00	0.18	0.49
			CV (%)	66.36	142.19	98.97	66.81	52.08	98.97	115.47	55.65	88.15	13.32	102.93	42.79
678	BT	U	0-15	11.70	24.00	0.01	0.05	1.21	0.001	0.01	1.180	0.081	0.010	0.201	0.713
678	BT	M	0-15	15.20	30.70	0.01	0.06	1.24	0.001	0.01	1.490	0.112	0.010	0.206	0.768
678	BT	L	0-15	12.60	4.88	0.01	0.11	1.40	0.001	0.01	1.630	0.135	0.006	0.106	0.892
680	BT	U	0-15	9.80	4.92	0.01	0.07	1.21	0.001	0.01	1.570	0.031	0.010	0.124	0.472
680	BT	M	0-15	5.50	11.60	0.01	0.08	1.43	0.001	0.01	1.480	0.065	0.009	0.131	0.556
680	BT	L	0-15	8.80	15.50	0.01	0.10	1.47	0.001	0.01	1.250	0.088	0.009	0.130	0.666
681	BT	U	0-15	7.30	2.56	0.01	0.06	1.32	0.001	0.01	1.220	0.054	0.006	0.113	0.516
681	BT	M	0-15	4.80	4.52	0.01	0.06	1.32	0.001	0.01	1.270	0.045	0.008	0.131	0.496
681	BT	L	0-15	6.50	2.43	0.01	0.07	1.15	0.001	0.01	1.320	0.094	0.007	0.104	0.517
684	BT	U	0-15	6.20	1.58	0.01	0.08	3.19	0.001	0.01	1.300	0.039	0.005	0.084	1.180
684	BT	M	0-15	8.20	8.58	0.01	0.07	3.92	0.001	0.01	1.390	0.089	0.008	0.147	0.833
684	BT	L	0-15	13.20	26.50	0.05	0.16	11.70	0.005	0.07	5.270	0.660	0.016	0.401	1.830
687	BT	U	0-15	14.90	20.50	0.02	0.08	2.20	0.002	0.03	2.900	0.062	0.011	0.289	0.759
687	BT	M	0-15	19.50	18.50	0.02	0.04	2.38	0.002	0.03	0.940	0.087	0.013	0.233	0.861
687	BT	L	0-15	21.30	2.53	0.01	0.08	1.97	0.001	0.01	0.708	0.086	0.009	0.168	0.953
688	BT	U	0-15	2.70	48.50	0.02	0.31	6.52	0.002	0.03	2.120	0.347	0.018	0.325	2.910
688	BT	M	0-15	3.70	27.70	0.01	0.14	3.94	0.001	0.01	1.000	0.166	0.009	0.222	1.910
688	BT	L	0-15	2.40	20.30	0.01	0.09	4.59	0.001	0.01	1.200	0.181	0.011	0.276	1.420
692	BT	U	0-15	11.50	11.60	0.02	0.18	3.59	0.002	0.03	1.730	0.061	0.012	0.172	2.820
692	BT	M	0-15	6.50	17.60	0.05	0.13	2.11	0.005	0.07	2.320	0.076	0.010	0.330	1.930
692	BT	L	0-15	4.80	17.20	0.02	0.21	3.08	0.002	0.03	2.200	0.133	0.013	0.775	1.600
703	BT	U	0-15	9.60	2.87	0.01	0.11	3.36	0.001	0.02	0.791	0.031	0.011	0.157	0.610
703	BT	M	0-15	6.80	7.47	0.02	0.08	2.97	0.002	0.03	1.070	0.038	0.011	0.142	0.459
703	BT	L	0-15	16.60	0.34	0.05	0.24	6.36	0.005	0.07	2.440	0.246	0.011	0.847	5.760
			Mean	9.59	13.87	0.02	0.11	3.07	0.002	0.02	1.66	0.13	0.01	0.24	1.31
			Max	21.30	48.50	0.05	0.31	11.70	0.005	0.07	5.27	0.66	0.02	0.85	5.76
			Min	2.40	0.34	0.01	0.04	1.15	0.001	0.01	0.71	0.03	0.01	0.08	0.46
			SD	5.18	11.87	0.01	0.07	2.40	0.001	0.02	0.94	0.14	0.00	0.19	1.18
			CV (%)	54.02	85.58	75.83	59.90	78.34	75.83	87.73	56.85	108.11	29.46	79.99	90.46

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
727	AP	U	0-15	35.40	3.05	0.02	0.11	5.07	0.002	0.03	1.400	0.186	0.012	0.201	1.270
727	AP	M	0-15	15.20	36.30	0.05	0.18	4.60	0.005	0.07	2.560	0.268	0.015	0.397	1.460
727	AP	L	0-15	74.70	22.90	0.02	0.18	2.64	0.002	0.03	2.450	0.285	0.012	0.474	1.530
728	AP	U	0-15	4.60	35.40	0.01	0.08	1.09	0.001	0.04	0.479	0.088	0.011	0.150	0.406
728	AP	M	0-15	11.20	24.80	0.05	0.13	2.13	0.005	0.07	0.772	0.145	0.008	0.219	0.680
728	AP	L	0-15	19.20	16.90	0.08	0.09	1.95	0.001	0.02	0.555	0.193	0.009	0.142	0.880
730	AP	U	0-15	5.80	1.50	0.05	0.10	2.11	0.005	0.07	1.020	0.054	0.008	0.081	1.010
730	AP	M	0-15	6.50	25.30	0.02	0.08	1.91	0.002	0.03	0.757	0.107	0.013	0.156	0.909
730	AP	L	0-15	4.10	1.98	0.02	0.10	1.73	0.002	0.03	0.391	0.179	0.009	0.136	1.130
738	AP	U	0-15	16.10	34.00	0.02	0.10	2.75	0.002	0.03	0.641	0.243	0.013	0.530	1.050
738	AP	M	0-15	12.80	48.00	0.02	0.11	2.29	0.002	0.03	0.571	0.270	0.014	0.596	1.010
738	AP	L	0-15	11.20	22.80	0.02	0.17	2.53	0.002	0.03	0.735	0.292	0.011	0.522	1.190
739	AP	U	0-15	3.50	16.30	0.05	0.11	3.93	0.005	0.07	0.737	0.141	0.008	0.332	0.639
739	AP	M	0-15	4.40	8.77	0.02	0.12	3.66	0.002	0.03	0.832	0.105	0.010	0.230	0.510
739	AP	L	0-15	3.10	24.20	0.05	0.17	3.28	0.005	0.07	0.943	0.148	0.012	0.370	0.534
740	AP	U	0-15	12.10	26.30	0.05	0.20	3.85	0.005	0.07	1.340	0.083	0.008	0.291	0.689
740	AP	M	0-15	18.60	16.50	0.02	0.13	2.89	0.002	0.03	1.050	0.172	0.016	0.410	1.120
740	AP	L	0-15	10.10	0.03	0.02	0.12	0.69	0.002	0.03	0.628	0.192	0.010	0.156	1.580
743	AP	U	0-15	2.80	0.03	0.02	0.07	3.96	0.002	0.03	1.410	0.068	0.007	0.080	1.800
743	AP	M	0-15	4.00	9.90	0.05	0.13	3.61	0.005	0.07	0.599	0.173	0.008	0.315	2.010
743	AP	L	0-15	4.00	30.40	0.02	0.20	3.52	0.002	0.03	0.309	0.231	0.014	0.438	1.490
744	AP	U	0-15	23.20	25.70	0.02	0.12	3.37	0.002	0.03	0.387	0.103	0.010	0.214	0.763
744	AP	M	0-15	15.10	19.10	0.01	0.14	3.37	0.001	0.01	0.720	0.161	0.010	0.243	0.831
744	AP	L	0-15	14.90	18.60	0.02	0.15	3.75	0.002	0.03	1.020	0.201	0.009	0.254	1.160
746	AP	U	0-15	2.50	0.96	0.05	0.10	3.49	0.005	0.07	1.240	0.190	0.012	0.127	0.931
746	AP	M	0-15	4.20	13.60	0.02	0.10	3.25	0.002	0.03	0.923	0.238	0.010	0.148	0.906
746	AP	L	0-15	4.40	21.80	0.02	0.14	3.38	0.002	0.03	0.666	0.258	0.011	0.141	1.020
			Mean	12.73	18.71	0.03	0.13	2.99	0.003	0.04	0.93	0.18	0.01	0.27	1.06
			Max	74.70	48.00	0.08	0.20	5.07	0.005	0.07	2.56	0.29	0.02	0.60	2.01
			Min	2.50	0.03	0.01	0.07	0.69	0.001	0.01	0.31	0.05	0.01	0.08	0.41
			SD	14.61	12.60	0.02	0.04	1.02	0.002	0.02	0.54	0.07	0.00	0.15	0.40
			CV (%)	114.80	67.35	58.10	28.70	34.15	54.08	47.86	58.44	38.97	22.15	54.40	37.49

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
769	MM	U	0-15	2.80	36.90	0.05	0.15	1.69	0.005	0.07	1.510	0.131	0.009	0.290	0.819
769	MM	M	0-15	3.50	57.40	0.01	0.10	1.69	0.001	0.09	0.545	0.240	0.015	0.333	0.663
769	MM	L	0-15	6.80	73.90	0.05	0.10	1.88	0.005	0.14	0.899	0.281	0.016	0.384	0.629
781	MM	U	0-15	11.40	73.00	0.05	0.10	3.08	0.005	0.07	0.004	0.189	0.017	0.558	1.240
781	MM	M	0-15	11.90	66.00	0.05	0.10	2.72	0.005	0.07	0.004	0.208	0.013	0.527	1.360
781	MM	L	0-15	15.90	63.50	0.05	0.10	1.66	0.005	0.07	1.250	0.168	0.014	0.668	1.420
786	MM	U	0-15	2.50	0.11	0.01	0.12	4.39	0.001	0.01	0.909	0.052	0.009	0.051	0.757
786	MM	M	0-15	3.20	0.17	0.01	0.05	4.60	0.001	0.01	0.600	0.076	0.009	0.041	0.457
786	MM	L	0-15	4.10	44.20	0.05	0.10	2.32	0.005	0.07	0.507	0.093	0.009	0.089	0.331
791	MM	U	0-15	3.00	7.94	0.01	0.09	4.41	0.001	0.01	0.257	0.241	0.009	0.189	1.320
791	MM	M	0-15	4.20	0.02	0.01	0.06	6.11	0.001	0.01	0.430	0.188	0.009	0.099	1.540
791	MM	L	0-15	5.00	1.77	0.01	0.13	5.94	0.001	0.01	0.341	0.466	0.007	0.248	2.910
793	MM	U	0-15	3.30	0.12	0.01	0.09	3.99	0.001	0.01	0.449	0.179	0.009	0.077	0.981
793	MM	M	0-15	3.10	0.13	0.01	0.07	3.94	0.001	0.01	0.473	0.180	0.009	0.125	0.968
793	MM	L	0-15	2.40	2.07	0.01	0.09	3.86	0.001	0.01	0.388	0.223	0.009	0.150	1.180
			Mean	5.54	28.48	0.03	0.10	3.49	0.003	0.04	0.57	0.19	0.01	0.26	1.11
			Max	15.90	73.90	0.05	0.15	6.11	0.005	0.14	1.51	0.47	0.02	0.67	2.91
			Min	2.40	0.02	0.01	0.05	1.66	0.001	0.01	0.00	0.05	0.01	0.04	0.33
			SD	4.15	31.27	0.02	0.03	1.49	0.002	0.04	0.42	0.10	0.00	0.20	0.62
			CV (%)	74.98	109.79	78.01	26.13	42.62	78.01	94.02	73.14	50.78	29.28	78.60	55.99
798	FG	U	0-15	19.10	15.10	0.01	0.12	3.37	0.001	0.01	0.558	0.246	0.008	0.146	0.918
798	FG	M	0-15	30.10	1.95	0.01	0.09	3.41	0.001	0.01	0.297	0.221	0.009	0.094	0.766
798	FG	L	0-15	17.80	19.20	0.01	0.12	3.62	0.001	0.01	0.516	0.229	0.007	0.106	0.904
800	FG	U	0-15	3.30	7.12	0.05	0.12	5.46	0.005	0.07	0.601	0.319	0.008	0.318	2.690
800	FG	M	0-15	4.60	9.36	0.05	0.17	5.42	0.005	0.07	0.674	0.329	0.010	0.334	2.770
800	FG	L	0-15	3.20	4.95	0.05	0.10	5.23	0.005	0.07	0.812	0.321	0.008	0.287	2.820
			Mean	13.02	9.61	0.03	0.12	4.42	0.003	0.04	0.58	0.28	0.01	0.21	1.81
			Max	30.10	19.20	0.05	0.17	5.46	0.005	0.07	0.81	0.33	0.01	0.33	2.82
			Min	3.20	1.95	0.01	0.09	3.37	0.001	0.01	0.30	0.22	0.01	0.09	0.77
			SD	11.08	6.46	0.02	0.03	1.05	0.002	0.03	0.17	0.05	0.00	0.11	1.04
			CV (%)	85.09	67.22	73.03	22.97	23.74	73.03	82.16	29.82	18.24	12.39	51.67	57.49

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
804	MG	U	0-15	3.20	1.51	0.01	0.04	3.51	0.001	0.01	0.541	0.081	0.007	0.124	0.836
804	MG	M	0-15	4.40	0.21	0.01	0.03	3.13	0.001	0.01	0.384	0.054	0.008	0.098	0.739
804	MG	L	0-15	3.60	2.89	0.01	0.08	2.26	0.001	0.01	0.191	0.119	0.009	0.140	0.952
806	MG	U	0-15	9.10	0.04	0.01	0.05	3.32	0.001	0.01	0.579	0.054	0.008	0.076	1.030
806	MG	M	0-15	6.70	1.94	0.01	0.13	2.41	0.001	0.01	0.215	0.082	0.007	0.184	0.937
806	MG	L	0-15	4.80	11.70	0.01	0.11	1.96	0.001	0.01	0.427	0.118	0.008	0.166	0.793
809	MG	U	0-15	4.10	0.02	0.01	0.08	2.92	0.001	0.01	0.612	0.086	0.009	0.073	1.570
809	MG	M	0-15	10.20	0.03	0.02	0.15	3.43	0.002	0.03	0.489	0.078	0.027	0.135	1.680
809	MG	L	0-15	14.20	0.70	0.01	0.16	2.96	0.001	0.01	0.352	0.121	0.008	0.095	0.864
812	MG	U	0-15	10.90	0.02	0.01	0.02	3.80	0.001	0.01	0.676	0.034	0.007	0.106	1.400
812	MG	M	0-15	8.70	0.02	0.01	0.02	2.98	0.001	0.01	0.675	0.033	0.006	0.080	1.260
812	MG	L	0-15	12.60	0.02	0.01	0.03	3.26	0.001	0.01	0.439	0.048	0.008	0.102	1.600
815	MG	U	0-15	4.90	0.02	0.01	0.05	4.61	0.001	0.01	0.691	0.070	0.008	0.070	1.150
815	MG	M	0-15	3.20	0.02	0.01	0.06	4.44	0.001	0.01	0.541	0.065	0.009	0.073	0.956
815	MG	L	0-15	3.60	0.05	0.02	0.18	2.50	0.002	0.03	0.665	0.330	0.008	0.211	2.240
823	MG	U	0-15	14.80	0.02	0.01	0.04	2.51	0.001	0.01	1.940	0.092	0.011	0.133	1.250
823	MG	M	0-15	23.00	0.02	0.01	0.10	2.55	0.001	0.01	1.600	0.148	0.010	0.156	0.864
823	MG	L	0-15	25.20	0.02	0.01	0.12	2.36	0.001	0.01	1.600	0.174	0.011	0.136	0.845
1828	MG	U	0-15	2.70	0.08	0.01	0.03	3.80	0.001	0.01	1.530	0.037	0.008	0.055	0.996
1828	MG	M	0-15	19.20	0.06	0.01	0.11	3.02	0.001	0.01	1.700	0.152	0.009	0.139	0.900
1828	MG	L	0-15	6.50	0.02	0.01	0.10	4.99	0.001	0.01	1.390	0.103	0.009	0.128	1.070
2828	MG	U	0-15	5.50	0.02	0.01	0.13	3.99	0.001	0.01	2.530	0.109	0.008	0.216	1.460
2828	MG	M	0-15	6.00	0.22	0.01	0.12	3.59	0.001	0.01	1.440	0.138	0.009	0.218	1.280
2828	MG	L	0-15	9.90	0.02	0.01	0.13	4.06	0.001	0.01	1.620	0.146	0.008	0.226	1.580
			Mean	9.04	0.82	0.01	0.09	3.27	0.001	0.01	0.95	0.10	0.01	0.13	1.18
			Max	25.20	11.70	0.02	0.18	4.99	0.002	0.03	2.53	0.33	0.03	0.23	2.24
			Min	2.70	0.02	0.01	0.02	1.96	0.001	0.01	0.19	0.03	0.01	0.06	0.74
			SD	6.32	2.43	0.00	0.05	0.79	0.000	0.01	0.64	0.06	0.00	0.05	0.37
			CV (%)	69.94	296.44	26.06	56.06	24.23	26.06	48.40	67.68	61.15	43.36	39.31	31.15

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
586	PL	U	0-15	120.0	0.540	0.089	177.0	8.38	0.002	1.99	1.64	0.063	7.46	0.002	4.46
586	PL	M	0-15	177.0	0.689	0.184	362.0	5.98	0.002	1.93	1.12	0.084	5.63	0.002	5.44
586	PL	L	0-15	184.0	0.658	0.130	312.0	5.77	0.004	1.74	1.67	0.074	6.85	0.002	4.15
588	PL	U	0-15	72.1	0.769	0.189	435.0	4.65	0.002	0.83	0.70	0.062	7.01	0.002	8.11
588	PL	M	0-15	39.4	0.889	0.213	634.0	5.60	0.002	0.65	0.55	0.049	9.40	0.002	9.10
588	PL	L	0-15	142.0	1.990	0.070	350.0	2.10	0.003	1.04	0.53	0.057	3.55	0.002	4.99
590	PL	U	0-15	57.0	0.921	0.116	394.0	6.24	0.002	0.75	0.73	0.051	9.14	0.002	7.14
590	PL	M	0-15	62.8	0.430	0.012	71.5	28.20	0.002	1.41	1.27	0.060	4.47	0.002	2.44
590	PL	L	0-15	82.6	0.569	0.014	73.8	37.20	0.002	1.87	1.98	0.084	5.39	0.002	2.47
591	PL	U	0-15	126.0	1.490	0.054	230.0	8.66	0.002	2.72	1.42	0.061	6.19	0.002	5.67
591	PL	M	0-15	103.0	0.995	0.132	286.0	5.82	0.002	4.19	1.40	0.065	10.00	0.002	7.57
591	PL	L	0-15	194.0	1.160	0.118	312.0	13.20	0.006	5.83	2.17	0.072	12.50	0.004	8.25
592	PL	U	0-15	73.4	0.912	0.150	326.0	6.84	0.009	1.64	2.38	0.054	22.60	0.002	5.40
592	PL	M	0-15	84.5	0.992	0.144	333.0	8.36	0.009	1.79	2.59	0.054	24.10	0.002	5.58
592	PL	L	0-15	90.7	1.160	0.159	341.0	10.50	0.018	2.13	2.89	0.068	26.80	0.004	6.10
593	PL	U	0-15	135.0	1.210	0.063	330.0	20.90	0.002	2.60	1.82	0.076	8.06	0.002	4.72
593	PL	M	0-15	184.0	1.020	0.138	319.0	20.60	0.002	3.33	1.51	0.089	7.03	0.002	5.07
593	PL	L	0-15	243.0	1.050	0.113	309.0	25.90	0.003	2.36	0.88	0.118	8.31	0.002	4.43
594	PL	U	0-15	103.0	1.160	0.007	221.0	21.40	0.002	1.08	0.92	0.074	4.69	0.002	3.16
594	PL	M	0-15	131.0	0.807	0.021	165.0	30.00	0.002	1.27	1.04	0.094	5.72	0.002	2.81
594	PL	L	0-15	204.0	0.975	0.038	155.0	14.90	0.002	1.41	1.25	0.102	6.64	0.002	2.54
595	PL	U	0-15	175.0	1.690	0.058	433.0	14.90	0.002	2.38	1.20	0.085	11.40	0.002	4.66
595	PL	M	0-15	160.0	1.390	0.030	292.0	26.90	0.002	2.59	1.15	0.091	11.30	0.002	3.78
595	PL	L	0-15	161.0	1.270	0.054	306.0	28.10	0.002	2.41	1.15	0.087	9.70	0.002	3.53
599	PL	U	0-15	244.0	1.630	0.112	453.0	26.30	0.004	3.49	1.38	0.120	14.20	0.004	6.77
599	PL	M	0-15	132.0	0.975	0.056	285.0	13.80	0.002	2.03	0.92	0.086	6.27	0.002	4.30
599	PL	L	0-15	226.0	1.660	0.074	517.0	28.20	0.004	4.04	1.00	0.130	10.20	0.004	6.49
			Mean	137.28	1.07	0.09	311.94	15.90	0.004	2.20	1.38	0.08	9.80	0.0023	5.15
			Max	244.00	1.99	0.21	634.00	37.20	0.018	5.83	2.89	0.13	26.80	0.0040	9.10
			Min	39.40	0.43	0.01	71.50	2.10	0.002	0.65	0.53	0.05	3.55	0.0020	2.44
			SD	57.94	0.38	0.06	124.62	10.04	0.004	1.18	0.61	0.02	5.91	0.0007	1.84
			CV (%)	42.20	35.51	62.14	39.95	63.12	98.46	53.55	43.93	27.55	60.27	31.53	35.74

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
615	MB	U	0-15	119.0	0.892	0.010	118.0	15.50	0.021	0.51	6.17	0.063	13.10	0.002	3.56
615	MB	M	0-15	177.0	0.832	0.044	136.0	22.50	0.002	1.01	1.75	0.059	5.05	0.002	3.48
615	MB	L	0-15	397.0	1.240	0.111	300.0	22.60	0.012	2.28	3.18	0.190	13.40	0.010	9.66
			Mean	231.00	0.99	0.06	184.67	20.20	0.0117	1.27	3.70	0.10	10.52	0.0047	5.57
			Max	397.00	1.24	0.11	300.00	22.60	0.0210	2.28	6.17	0.19	13.40	0.0100	9.66
			Min	119.00	0.83	0.01	118.00	15.50	0.0020	0.51	1.75	0.06	5.05	0.0020	3.48
			SD	146.66	0.22	0.05	100.29	4.07	0.0095	0.91	2.26	0.07	4.74	0.0046	3.55
			CV (%)	63.49	22.30	93.44	54.31	20.15	81.47	71.88	60.96	71.64	45.04	98.97	63.69
678	BT	U	0-15	82.5	0.794	0.017	218.0	38.70	0.002	0.93	1.21	0.056	5.85	0.002	9.73
678	BT	M	0-15	134.0	1.040	0.046	211.0	28.50	0.002	1.07	1.74	0.083	7.39	0.002	9.19
678	BT	L	0-15	129.0	0.986	0.190	377.0	17.00	0.002	1.85	1.10	0.073	10.50	0.002	13.00
680	BT	U	0-15	49.5	0.508	0.031	244.0	17.90	0.002	0.63	0.78	0.049	3.79	0.002	2.21
680	BT	M	0-15	66.0	0.519	0.032	216.0	22.90	0.002	1.06	1.30	0.058	4.87	0.002	2.44
680	BT	L	0-15	103.0	0.557	0.023	212.0	17.70	0.006	1.42	2.04	0.072	5.55	0.002	2.37
681	BT	U	0-15	64.9	0.445	0.019	86.5	15.20	0.002	0.99	0.87	0.053	5.46	0.002	3.48
681	BT	M	0-15	67.7	0.517	0.007	90.1	13.60	0.002	0.98	1.02	0.061	4.30	0.002	3.21
681	BT	L	0-15	91.6	0.531	0.062	116.0	15.80	0.002	1.38	1.05	0.064	6.54	0.002	3.94
684	BT	U	0-15	43.5	0.589	0.015	160.0	9.73	0.002	0.70	0.57	0.035	3.35	0.002	3.98
684	BT	M	0-15	77.3	0.791	0.016	131.0	20.00	0.002	1.47	1.12	0.062	3.65	0.002	4.32
684	BT	L	0-15	421.0	2.520	0.028	168.0	91.20	0.010	4.75	6.71	0.280	13.80	0.010	9.24
687	BT	U	0-15	78.1	0.756	0.017	46.6	39.80	0.004	1.11	1.20	0.042	4.39	0.004	2.39
687	BT	M	0-15	76.5	0.769	0.011	59.2	36.60	0.004	1.19	1.36	0.079	4.91	0.004	3.04
687	BT	L	0-15	82.4	0.860	0.046	116.0	27.00	0.002	1.33	1.40	0.076	8.71	0.002	5.01
688	BT	U	0-15	278.0	0.706	0.132	624.0	55.70	0.005	5.87	2.91	0.094	24.30	0.004	16.50
688	BT	M	0-15	151.0	0.517	0.068	324.0	30.60	0.004	3.42	1.38	0.065	13.30	0.002	8.67
688	BT	L	0-15	188.0	0.630	0.052	210.0	45.20	0.007	3.77	1.62	0.084	13.00	0.002	7.85
692	BT	U	0-15	127.0	1.730	0.084	550.0	18.20	0.004	2.25	1.00	0.068	8.76	0.004	9.89
692	BT	M	0-15	200.0	1.680	0.114	665.0	41.70	0.010	1.75	1.20	0.140	7.86	0.010	10.50
692	BT	L	0-15	238.0	1.510	0.072	413.0	85.10	0.011	3.33	1.58	0.082	15.70	0.004	8.72
703	BT	U	0-15	52.1	0.546	0.010	156.0	21.50	0.002	0.78	0.88	0.037	3.49	0.002	4.52
703	BT	M	0-15	59.0	0.542	0.005	120.0	22.30	0.004	0.63	0.86	0.035	2.39	0.004	3.42
703	BT	L	0-15	390.0	1.800	0.067	383.0	52.80	0.047	5.00	3.54	0.110	10.60	0.010	8.50
			Mean	135.42	0.91	0.05	245.68	32.70	0.0058	1.99	1.60	0.08	8.02	0.0035	6.51
			Max	421.00	2.52	0.19	665.00	91.20	0.0470	5.87	6.71	0.28	24.30	0.0100	16.50
			Min	43.50	0.45	0.01	46.60	9.73	0.0020	0.63	0.57	0.04	2.39	0.0020	2.21
			SD	103.47	0.54	0.05	173.83	21.23	0.0092	1.52	1.27	0.05	5.11	0.0027	3.87
			CV (%)	76.40	59.32	93.42	70.75	64.94	157.90	76.72	79.54	63.79	63.77	75.83	59.49

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
727	AP	U	0-15	103.0	2.200	0.105	397.0	27.90	0.009	2.58	2.53	0.042	15.10	0.004	7.50
727	AP	M	0-15	243.0	2.000	0.141	402.0	53.50	0.010	3.93	4.17	0.040	18.30	0.010	7.91
727	AP	L	0-15	321.0	1.820	0.087	263.0	54.60	0.010	5.20	3.32	0.110	16.10	0.004	5.71
728	AP	U	0-15	91.2	0.628	0.034	120.0	25.00	0.012	0.91	0.91	0.076	6.60	0.002	2.30
728	AP	M	0-15	136.0	1.340	0.067	138.0	40.30	0.021	2.03	1.30	0.047	13.10	0.010	4.10
728	AP	L	0-15	140.0	4.440	0.034	95.9	25.00	0.024	1.81	4.62	0.045	15.40	0.002	3.65
730	AP	U	0-15	37.0	0.450	0.018	244.0	11.40	0.010	1.42	0.46	0.040	5.98	0.010	2.63
730	AP	M	0-15	93.0	0.560	0.025	156.0	25.20	0.015	1.34	0.97	0.072	5.45	0.004	2.22
730	AP	L	0-15	133.0	0.758	0.062	339.0	30.00	0.004	2.01	0.61	0.080	9.29	0.004	3.02
738	AP	U	0-15	88.8	0.736	0.024	165.0	75.20	0.009	1.76	0.61	0.094	6.46	0.004	4.23
738	AP	M	0-15	103.0	0.789	0.020	144.0	89.50	0.010	1.65	1.10	0.100	7.75	0.004	4.07
738	AP	L	0-15	98.9	0.784	0.035	151.0	79.40	0.007	2.71	0.82	0.120	6.97	0.004	4.25
739	AP	U	0-15	75.8	0.708	0.027	139.0	44.40	0.010	2.35	0.71	0.046	4.51	0.010	3.38
739	AP	M	0-15	55.9	0.557	0.042	143.0	26.40	0.004	1.79	0.80	0.080	3.90	0.004	3.81
739	AP	L	0-15	74.7	0.714	0.037	113.0	47.70	0.017	1.84	0.64	0.071	5.07	0.010	3.54
740	AP	U	0-15	68.3	1.020	0.060	266.0	29.10	0.010	1.84	0.57	0.040	6.07	0.010	5.30
740	AP	M	0-15	88.0	1.010	0.033	170.0	72.30	0.008	2.19	0.64	0.110	7.68	0.004	4.27
740	AP	L	0-15	83.4	1.750	0.553	508.0	28.80	0.030	1.81	3.70	0.079	25.20	0.004	9.31
743	AP	U	0-15	10.9	0.485	0.072	414.0	9.45	0.004	1.42	0.15	0.048	16.60	0.004	6.51
743	AP	M	0-15	81.7	0.723	0.071	414.0	49.00	0.014	3.45	0.49	0.120	7.43	0.010	5.69
743	AP	L	0-15	97.4	0.816	0.051	312.0	68.30	0.010	2.60	0.61	0.093	10.30	0.004	4.90
744	AP	U	0-15	111.0	1.030	0.026	166.0	26.40	0.004	2.43	1.23	0.037	7.02	0.004	4.42
744	AP	M	0-15	147.0	15.400	0.034	123.0	34.50	0.007	2.91	1.18	0.088	10.30	0.002	4.70
744	AP	L	0-15	224.0	1.110	0.038	123.0	36.10	0.008	4.09	1.79	0.099	11.20	0.004	4.06
746	AP	U	0-15	62.0	0.684	0.037	196.0	26.30	0.010	2.19	0.93	0.040	13.80	0.010	3.17
746	AP	M	0-15	108.0	0.872	0.040	158.0	36.00	0.004	2.31	0.97	0.076	11.70	0.004	2.87
746	AP	L	0-15	144.0	1.130	0.027	154.0	30.70	0.004	2.44	1.10	0.076	14.20	0.004	2.77
			Mean	111.85	1.65	0.07	222.74	40.83	0.0106	2.33	1.37	0.07	10.43	0.0056	4.46
			Max	321.00	15.40	0.55	508.00	89.50	0.0300	5.20	4.62	0.12	25.20	0.0100	9.31
			Min	10.90	0.45	0.02	95.90	9.45	0.0040	0.91	0.15	0.04	3.90	0.0020	2.22
			SD	64.38	2.86	0.10	117.07	20.79	0.0063	0.94	1.20	0.03	5.12	0.0030	1.74
			CV (%)	57.55	173.76	151.84	52.56	50.92	60.11	40.12	88.01	37.28	49.09	54.08	39.06

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
769	MM	U	0-15	97.1	0.692	0.108	257.0	50.90	0.010	1.71	1.40	0.040	11.30	0.010	4.77
769	MM	M	0-15	120.0	0.634	0.036	71.0	92.30	0.008	1.43	1.99	0.103	11.20	0.002	2.79
769	MM	L	0-15	154.0	0.828	0.044	80.0	76.70	0.015	1.60	2.50	0.140	12.50	0.010	3.14
781	MM	U	0-15	142.0	1.330	0.064	217.0	66.70	0.010	1.72	1.90	0.081	14.70	0.010	4.23
781	MM	M	0-15	153.0	1.400	0.084	233.0	59.40	0.020	2.48	1.60	0.130	17.00	0.010	4.40
781	MM	L	0-15	183.0	1.490	0.065	261.0	65.80	0.015	2.32	2.00	0.220	15.00	0.010	3.84
786	MM	U	0-15	23.9	0.398	0.035	197.0	7.37	0.002	1.65	0.61	0.020	10.70	0.002	4.19
786	MM	M	0-15	22.8	0.310	0.022	146.0	6.22	0.002	1.18	0.94	0.046	12.10	0.002	4.36
786	MM	L	0-15	133.0	0.663	0.010	57.0	5.53	0.010	0.72	1.20	0.110	2.42	0.010	2.01
791	MM	U	0-15	76.6	0.654	0.037	116.0	41.10	0.003	2.15	0.91	0.092	5.58	0.002	2.72
791	MM	M	0-15	60.8	0.759	0.047	156.0	19.80	0.004	2.02	0.55	0.077	12.00	0.002	4.21
791	MM	L	0-15	414.0	1.700	0.038	105.0	43.70	0.007	3.69	0.83	0.190	6.45	0.002	2.65
793	MM	U	0-15	35.2	0.546	0.050	141.0	17.00	0.004	1.20	0.59	0.074	12.40	0.002	2.32
793	MM	M	0-15	28.7	0.524	0.051	140.0	26.20	0.004	1.22	0.53	0.078	11.70	0.002	2.01
793	MM	L	0-15	54.3	0.706	0.048	122.0	34.50	0.002	1.55	0.68	0.093	7.79	0.002	1.81
			Mean	113.23	0.84	0.05	153.27	40.88	0.0077	1.78	1.22	0.10	10.86	0.0052	3.30
			Max	414.00	1.70	0.11	261.00	92.30	0.0200	3.69	2.50	0.22	17.00	0.0100	4.77
			Min	22.80	0.31	0.01	57.00	5.53	0.0020	0.72	0.53	0.02	2.42	0.0020	1.81
			SD	98.94	0.43	0.02	66.11	27.40	0.0056	0.71	0.64	0.05	3.84	0.0041	1.03
			CV (%)	87.38	50.50	48.83	43.13	67.02	72.07	39.77	52.92	53.79	35.38	78.01	31.21
798	FG	U	0-15	81.3	0.798	0.025	105.0	33.80	0.002	1.93	1.11	0.078	7.80	0.002	2.69
798	FG	M	0-15	52.6	1.780	0.018	134.0	24.10	0.003	1.39	0.72	0.086	9.58	0.002	3.06
798	FG	L	0-15	96.7	0.858	0.009	103.0	22.20	0.003	1.46	0.88	0.076	6.16	0.002	2.52
800	FG	U	0-15	128.0	1.630	0.111	228.0	55.70	0.021	4.28	0.84	0.120	10.80	0.010	3.61
800	FG	M	0-15	126.0	1.560	0.120	284.0	60.30	0.023	4.40	1.00	0.170	11.90	0.010	4.08
800	FG	L	0-15	127.0	1.670	0.122	289.0	50.10	0.021	4.29	0.89	0.150	11.70	0.010	4.48
			Mean	101.93	1.38	0.07	190.50	41.03	0.0122	2.96	0.91	0.11	9.66	0.0060	3.41
			Max	128.00	1.78	0.12	289.00	60.30	0.0230	4.40	1.11	0.17	11.90	0.0100	4.48
			Min	52.60	0.80	0.01	103.00	22.20	0.0020	1.39	0.72	0.08	6.16	0.0020	2.52
			SD	30.90	0.44	0.06	87.19	16.51	0.0104	1.51	0.13	0.04	2.29	0.0044	0.78
			CV (%)	30.31	31.53	81.94	45.77	40.23	85.80	50.95	14.82	35.27	23.70	73.03	22.99

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
804	MG	U	0-15	49.6	0.395	0.076	160.0	16.30	0.002	1.80	0.69	0.076	7.10	0.002	4.04
804	MG	M	0-15	32.8	0.336	0.127	209.0	11.60	0.002	1.35	0.60	0.067	10.70	0.002	4.62
804	MG	L	0-15	76.8	0.465	0.168	235.0	17.70	0.005	1.65	0.92	0.083	7.11	0.002	3.98
806	MG	U	0-15	30.7	0.385	0.146	347.0	7.78	0.004	1.59	0.40	0.073	11.20	0.002	5.33
806	MG	M	0-15	61.2	0.409	0.121	238.0	19.50	0.003	1.65	0.48	0.087	4.63	0.002	3.97
806	MG	L	0-15	81.5	0.460	0.058	134.0	23.80	0.002	1.26	0.78	0.065	4.27	0.002	3.15
809	MG	U	0-15	14.6	0.397	0.045	277.0	11.70	0.002	1.12	0.38	0.034	17.50	0.002	2.91
809	MG	M	0-15	28.2	0.528	0.074	369.0	18.40	0.004	1.98	0.42	0.043	9.92	0.004	3.65
809	MG	L	0-15	45.4	0.307	0.049	181.0	18.30	0.002	1.16	0.45	0.047	9.07	0.002	3.06
812	MG	U	0-15	16.4	0.724	0.181	396.0	9.82	0.002	1.23	0.11	0.032	15.00	0.002	10.30
812	MG	M	0-15	24.3	0.738	0.187	420.0	8.31	0.004	1.25	0.19	0.037	15.00	0.002	9.06
812	MG	L	0-15	23.1	0.863	0.214	498.0	11.80	0.004	1.44	0.34	0.042	17.50	0.002	9.01
815	MG	U	0-15	8.9	0.459	0.047	133.0	8.04	0.002	0.87	0.25	0.038	21.00	0.002	3.63
815	MG	M	0-15	10.0	0.429	0.043	119.0	8.67	0.002	0.83	0.32	0.043	21.80	0.002	3.00
815	MG	L	0-15	285.0	1.370	0.044	158.0	50.30	0.016	2.57	1.22	0.140	12.60	0.004	2.86
823	MG	U	0-15	10.5	0.571	0.090	250.0	13.60	0.003	1.38	0.26	0.057	26.60	0.002	4.51
823	MG	M	0-15	19.1	0.469	0.078	253.0	25.50	0.006	1.21	1.00	0.064	23.80	0.002	3.85
823	MG	L	0-15	24.0	0.454	0.059	229.0	27.90	0.003	1.26	0.35	0.067	17.70	0.002	3.51
1828	MG	U	0-15	7.2	0.340	0.039	140.0	6.18	0.002	0.69	0.14	0.050	16.60	0.002	3.45
1828	MG	M	0-15	28.8	0.416	0.046	189.0	27.60	0.004	1.17	0.48	0.076	15.00	0.002	2.83
1828	MG	L	0-15	15.8	0.569	0.060	224.0	19.40	0.002	1.11	0.24	0.064	21.50	0.002	3.26
2828	MG	U	0-15	34.6	0.698	0.077	249.0	27.90	0.002	1.83	0.30	0.068	11.70	0.002	3.25
2828	MG	M	0-15	39.1	0.565	0.055	195.0	35.30	0.002	1.69	0.35	0.075	9.22	0.002	2.67
2828	MG	L	0-15	36.1	0.732	0.064	245.0	30.70	0.002	1.94	0.34	0.069	12.80	0.002	3.23
			Mean	41.82	0.54	0.09	243.67	19.00	0.0034	1.42	0.46	0.06	14.14	0.0022	4.30
			Max	285.00	1.37	0.21	498.00	50.30	0.0160	2.57	1.22	0.14	26.60	0.0040	10.30
			Min	7.15	0.31	0.04	119.00	6.18	0.0020	0.69	0.11	0.03	4.27	0.0020	2.67
			SD	55.51	0.23	0.05	98.41	10.62	0.0029	0.42	0.28	0.02	6.03	0.0006	2.10
			CV (%)	132.75	42.04	59.20	40.39	55.89	85.40	29.77	60.92	37.20	42.67	26.06	48.88

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
586	PL	U	0-15	24.90	0.008	0.041	0.0010	0.002	16.30	0.02	0.07	1.220	0.02	0.005	0.055	0.008
586	PL	M	0-15	27.60	0.008	0.032	0.0015	0.002	10.80	0.02	0.04	1.580	0.02	0.011	0.082	0.008
586	PL	L	0-15	28.30	0.008	0.045	0.0019	0.002	7.98	0.02	0.07	1.260	0.02	0.013	0.080	0.008
588	PL	U	0-15	19.50	0.008	0.036	0.0008	0.002	0.99	0.02	0.05	0.974	0.02	0.017	0.130	0.022
588	PL	M	0-15	19.10	0.008	0.049	0.0012	0.003	1.52	0.02	0.05	1.040	0.02	0.011	0.114	0.008
588	PL	L	0-15	23.20	0.008	0.028	0.0018	0.003	2.55	0.02	0.04	1.120	0.02	0.007	0.138	0.008
590	PL	U	0-15	20.50	0.008	0.047	0.0008	0.002	1.77	0.02	0.07	0.483	0.02	0.006	0.084	0.008
590	PL	M	0-15	14.90	0.008	0.052	0.0031	0.003	3.67	0.02	0.04	0.924	0.02	0.009	0.054	0.008
590	PL	L	0-15	15.70	0.008	0.050	0.0049	0.006	5.48	0.02	0.04	0.935	0.02	0.010	0.063	0.008
591	PL	U	0-15	16.40	0.008	0.042	0.0052	0.002	3.78	0.02	0.04	1.030	0.04	0.017	0.070	0.008
591	PL	M	0-15	22.00	0.008	0.038	0.0015	0.004	10.30	0.02	0.05	1.670	0.05	0.014	0.074	0.008
591	PL	L	0-15	25.50	0.016	0.018	0.0018	0.004	13.50	0.02	0.04	2.040	0.03	0.028	0.094	0.008
592	PL	U	0-15	17.00	0.008	0.035	0.0019	0.007	8.03	0.02	0.08	0.491	0.04	0.005	0.087	0.008
592	PL	M	0-15	17.80	0.008	0.040	0.0011	0.005	8.10	0.02	0.05	0.557	0.04	0.008	0.088	0.008
592	PL	L	0-15	19.60	0.016	0.045	0.0020	0.005	9.10	0.02	0.08	0.678	0.07	0.005	0.084	0.008
593	PL	U	0-15	18.50	0.008	0.045	0.0058	0.004	9.80	0.04	0.08	1.510	0.03	0.016	0.070	0.020
593	PL	M	0-15	14.60	0.008	0.048	0.0022	0.002	8.70	0.02	0.06	1.220	0.03	0.012	0.081	0.008
593	PL	L	0-15	17.50	0.008	0.058	0.0038	0.004	6.63	0.02	0.04	0.874	0.04	0.017	0.070	0.011
594	PL	U	0-15	35.60	0.008	0.049	0.0087	0.002	1.36	0.02	0.04	0.548	0.02	0.013	0.053	0.038
594	PL	M	0-15	34.80	0.008	0.068	0.0067	0.002	2.38	0.02	0.04	0.605	0.07	0.027	0.064	0.008
594	PL	L	0-15	41.90	0.008	0.072	0.0081	0.004	2.33	0.02	0.06	0.542	0.02	0.025	0.047	0.026
595	PL	U	0-15	24.60	0.008	0.046	0.0135	0.004	5.93	0.04	0.08	1.290	0.03	0.013	0.066	0.027
595	PL	M	0-15	27.60	0.008	0.049	0.0234	0.013	12.00	0.02	0.04	1.100	0.04	0.011	0.051	0.025
595	PL	L	0-15	24.50	0.008	0.044	0.0122	0.006	7.03	0.02	0.04	0.880	0.04	0.009	0.046	0.011
599	PL	U	0-15	20.20	0.016	0.058	0.0093	0.004	5.63	0.07	0.08	1.250	0.03	0.015	0.078	0.024
599	PL	M	0-15	14.80	0.008	0.059	0.0059	0.005	2.90	0.10	0.08	1.680	0.05	0.025	0.118	0.016
599	PL	L	0-15	19.70	0.016	0.051	0.0069	0.004	5.18	0.04	0.08	1.460	0.03	0.024	0.095	0.016
			Mean	22.46	0.0092	0.05	0.0051	0.0039	6.43	0.03	0.06	1.07	0.03	0.01	0.08	0.01
			Max	41.90	0.0160	0.07	0.0234	0.0130	16.30	0.10	0.08	2.04	0.07	0.03	0.14	0.04
			Min	14.60	0.0080	0.02	0.0008	0.0020	0.99	0.02	0.04	0.48	0.02	0.01	0.05	0.01
			SD	6.83	0.0029	0.01	0.0051	0.0023	4.04	0.02	0.02	0.41	0.01	0.01	0.02	0.01
			CV (%)	30.39	31.53	24.79	100.74	59.08	62.77	67.90	30.17	38.50	44.70	49.79	30.57	61.80

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
615	MB	U	0-15	21.20	0.008	0.070	0.0172	0.026	16.10	0.06	0.04	1.840	0.04	0.024	0.153	0.008
615	MB	M	0-15	19.20	0.008	0.054	0.0081	0.002	3.00	0.04	0.04	0.669	0.02	0.040	0.079	0.008
615	MB	L	0-15	45.80	0.040	0.061	0.0083	0.010	14.70	0.07	0.08	2.120	0.03	0.015	0.098	0.016
			Mean	28.73	0.0187	0.06	0.0112	0.0127	11.27	0.06	0.05	1.54	0.03	0.03	0.11	0.01
			Max	45.80	0.0400	0.07	0.0172	0.0260	16.10	0.07	0.08	2.12	0.04	0.04	0.15	0.02
			Min	19.20	0.0080	0.05	0.0081	0.0020	3.00	0.04	0.04	0.67	0.02	0.02	0.08	0.01
			SD	14.81	0.0185	0.01	0.0052	0.0122	7.19	0.02	0.02	0.77	0.01	0.01	0.04	0.00
			CV (%)	51.56	98.97	13.01	46.40	96.48	63.85	26.96	43.30	49.89	33.33	48.08	34.94	43.30
678	BT	U	0-15	23.80	0.008	0.058	0.0008	0.002	3.24	0.02	0.04	0.793	0.05	0.009	0.033	0.021
678	BT	M	0-15	30.80	0.008	0.067	0.0119	0.003	6.06	0.02	0.04	0.888	0.09	0.022	0.028	0.008
678	BT	L	0-15	28.90	0.008	0.047	0.0033	0.002	8.61	0.02	0.04	1.490	0.03	0.009	0.023	0.014
680	BT	U	0-15	14.10	0.008	0.074	0.0057	0.003	0.85	0.02	0.04	0.448	0.06	0.012	0.029	0.012
680	BT	M	0-15	14.50	0.008	0.073	0.0074	0.005	1.52	0.02	0.04	0.726	0.02	0.010	0.024	0.008
680	BT	L	0-15	15.60	0.008	0.061	0.0100	0.004	2.99	0.02	0.04	0.922	0.02	0.018	0.037	0.008
681	BT	U	0-15	11.40	0.008	0.062	0.0029	0.002	1.41	0.02	0.06	0.816	0.06	0.039	0.054	0.008
681	BT	M	0-15	12.00	0.008	0.077	0.0030	0.002	0.66	0.02	0.04	0.508	0.02	0.010	0.021	0.008
681	BT	L	0-15	12.40	0.008	0.060	0.0025	0.002	2.29	0.03	0.04	0.910	0.03	0.017	0.027	0.008
684	BT	U	0-15	13.40	0.008	0.055	0.0018	0.002	0.61	0.02	0.04	0.294	0.06	0.011	0.050	0.008
684	BT	M	0-15	17.70	0.008	0.065	0.0041	0.002	1.47	0.02	0.04	0.511	0.03	0.034	0.044	0.008
684	BT	L	0-15	49.80	0.040	0.150	0.0190	0.012	17.10	0.02	0.04	0.767	0.02	0.019	0.030	0.008
687	BT	U	0-15	16.90	0.016	0.110	0.0082	0.008	1.10	0.02	0.05	0.368	0.02	0.024	0.056	0.008
687	BT	M	0-15	19.60	0.016	0.059	0.0076	0.008	1.64	0.02	0.07	0.510	0.02	0.015	0.060	0.008
687	BT	L	0-15	24.20	0.008	0.066	0.0033	0.007	2.11	0.02	0.14	1.050	0.02	0.026	0.062	0.031
688	BT	U	0-15	39.30	0.016	0.100	0.0268	0.004	14.90	0.02	0.04	1.240	0.02	0.004	0.050	0.008
688	BT	M	0-15	18.40	0.008	0.063	0.0222	0.003	8.01	0.02	0.12	1.260	0.02	0.012	0.058	0.016
688	BT	L	0-15	18.00	0.008	0.060	0.0204	0.011	10.40	0.02	0.07	1.160	0.02	0.011	0.043	0.008
692	BT	U	0-15	25.20	0.016	0.041	0.0068	0.004	3.83	0.04	0.08	1.230	0.03	0.010	0.103	0.020
692	BT	M	0-15	30.60	0.040	0.044	0.0078	0.010	1.49	0.04	0.08	0.853	0.03	0.011	0.051	0.016
692	BT	L	0-15	27.60	0.035	0.042	0.0196	0.004	3.96	0.04	0.10	0.838	0.03	0.017	0.040	0.020
703	BT	U	0-15	14.70	0.008	0.090	0.0039	0.002	0.35	0.02	0.06	0.371	0.02	0.020	0.050	0.023
703	BT	M	0-15	15.10	0.016	0.099	0.0081	0.004	0.20	0.02	0.08	0.322	0.02	0.023	0.038	0.012
703	BT	L	0-15	67.40	0.040	0.030	0.0210	0.170	15.60	0.04	0.08	0.714	0.03	0.011	0.106	0.020
			Mean	23.39	0.0148	0.07	0.0095	0.0115	4.60	0.02	0.06	0.79	0.03	0.02	0.05	0.01
			Max	67.40	0.0400	0.15	0.0268	0.1700	17.10	0.04	0.14	1.49	0.09	0.04	0.11	0.03
			Min	11.40	0.0080	0.03	0.0008	0.0020	0.20	0.02	0.04	0.29	0.02	0.00	0.02	0.01
			SD	13.28	0.0114	0.03	0.0077	0.0339	5.14	0.01	0.03	0.33	0.02	0.01	0.02	0.01
			CV (%)	56.75	77.39	37.75	80.71	294.78	111.67	32.41	46.01	42.02	57.38	50.99	46.79	50.72

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
727	AP	U	0-15	30.40	0.016	0.071	0.0062	0.004	10.20	0.04	0.08	1.320	0.04	0.007	0.066	0.020
727	AP	M	0-15	44.80	0.040	0.030	0.0300	0.034	9.00	0.02	0.04	1.440	0.02	0.007	0.045	0.008
727	AP	L	0-15	44.10	0.016	0.060	0.0241	0.014	11.00	0.04	0.08	1.380	0.03	0.017	0.052	0.020
728	AP	U	0-15	15.60	0.008	0.073	0.0275	0.012	2.31	0.02	0.08	0.959	0.03	0.017	0.045	0.013
728	AP	M	0-15	24.60	0.040	0.080	0.0140	0.014	5.78	0.02	0.05	1.860	0.02	0.008	0.060	0.015
728	AP	L	0-15	30.20	0.008	0.057	0.0555	0.047	22.70	0.02	0.07	2.320	0.03	0.007	0.096	0.015
730	AP	U	0-15	18.10	0.040	0.066	0.0040	0.014	0.53	0.02	0.04	0.287	0.02	0.005	0.125	0.008
730	AP	M	0-15	18.90	0.016	0.059	0.0097	0.008	2.17	0.02	0.15	0.645	0.03	0.019	0.068	0.034
730	AP	L	0-15	16.50	0.016	0.081	0.0038	0.006	4.60	0.02	0.10	1.360	0.03	0.018	0.065	0.023
738	AP	U	0-15	29.00	0.016	0.069	0.0140	0.005	5.31	0.02	0.06	0.801	0.02	0.021	0.077	0.008
738	AP	M	0-15	22.80	0.016	0.070	0.0201	0.011	6.99	0.02	0.09	0.755	0.02	0.020	0.065	0.008
738	AP	L	0-15	19.90	0.016	0.081	0.0082	0.004	5.66	0.02	0.08	0.911	0.02	0.016	0.062	0.008
739	AP	U	0-15	16.40	0.040	0.120	0.0045	0.010	3.92	0.02	0.10	0.482	0.03	0.020	0.044	0.013
739	AP	M	0-15	13.90	0.016	0.092	0.0041	0.005	1.66	0.02	0.06	0.428	0.02	0.010	0.048	0.008
739	AP	L	0-15	16.30	0.040	0.110	0.0075	0.010	3.12	0.02	0.06	0.574	0.02	0.019	0.060	0.019
740	AP	U	0-15	27.80	0.040	0.076	0.0057	0.010	1.25	0.02	0.10	0.670	0.02	0.021	0.073	0.015
740	AP	M	0-15	33.00	0.016	0.053	0.0084	0.004	5.33	0.02	0.06	1.320	0.02	0.011	0.085	0.008
740	AP	L	0-15	711.00	0.016	0.069	0.0072	0.154	7.22	0.02	0.10	1.290	0.03	0.014	0.148	0.008
743	AP	U	0-15	13.00	0.016	0.072	0.0020	0.011	1.06	0.02	0.04	0.463	0.02	0.005	0.115	0.008
743	AP	M	0-15	20.20	0.040	0.049	0.0054	0.010	3.51	0.02	0.07	0.672	0.03	0.010	0.058	0.008
743	AP	L	0-15	20.70	0.016	0.058	0.0110	0.004	3.59	0.02	0.20	0.620	0.04	0.028	0.084	0.068
744	AP	U	0-15	19.80	0.016	0.051	0.0085	0.004	1.49	0.02	0.09	0.817	0.02	0.008	0.040	0.008
744	AP	M	0-15	19.90	0.008	0.048	0.0190	0.011	5.37	0.02	0.05	1.070	0.02	0.007	0.047	0.008
744	AP	L	0-15	24.00	0.016	0.037	0.0174	0.009	7.38	0.02	0.13	1.060	0.02	0.020	0.076	0.040
746	AP	U	0-15	16.90	0.040	0.030	0.0040	0.010	2.09	0.02	0.06	0.843	0.02	0.004	0.117	0.008
746	AP	M	0-15	16.90	0.016	0.061	0.0092	0.004	4.26	0.02	0.15	1.030	0.02	0.010	0.069	0.044
746	AP	L	0-15	20.20	0.016	0.048	0.0188	0.009	5.09	0.02	0.05	1.490	0.02	0.005	0.069	0.008
			Mean	48.33	0.0222	0.07	0.0130	0.0162	5.28	0.02	0.08	1.00	0.02	0.01	0.07	0.02
			Max	711.00	0.0400	0.12	0.0555	0.1540	22.70	0.04	0.20	2.32	0.04	0.03	0.15	0.07
			Min	13.00	0.0080	0.03	0.0020	0.0040	0.53	0.02	0.04	0.29	0.02	0.00	0.04	0.01
			SD	132.69	0.0120	0.02	0.0114	0.0291	4.44	0.01	0.04	0.47	0.01	0.01	0.03	0.01
			CV (%)	274.54	54.08	31.97	88.32	179.23	84.06	24.85	46.06	47.12	26.20	50.43	37.26	86.13

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
769	MM	U	0-15	36.00	0.040	0.030	0.0140	0.010	2.00	0.02	0.10	0.720	0.02	0.028	0.053	0.016
769	MM	M	0-15	28.30	0.008	0.089	0.0924	0.025	4.56	0.02	0.05	0.740	0.02	0.025	0.039	0.008
769	MM	L	0-15	34.20	0.040	0.110	0.1050	0.030	5.43	0.02	0.09	0.837	0.02	0.033	0.046	0.008
781	MM	U	0-15	34.40	0.040	0.074	0.0533	0.034	3.13	0.02	0.07	0.945	0.02	0.029	0.062	0.008
781	MM	M	0-15	37.20	0.050	0.100	0.0482	0.040	2.85	0.02	0.08	1.010	0.03	0.022	0.071	0.008
781	MM	L	0-15	41.00	0.040	0.093	0.0330	0.023	2.87	0.02	0.08	1.030	0.05	0.035	0.061	0.008
786	MM	U	0-15	12.80	0.008	0.079	0.0018	0.003	0.84	0.02	0.07	0.706	0.03	0.007	0.109	0.014
786	MM	M	0-15	9.09	0.008	0.070	0.0019	0.008	0.70	0.02	0.10	0.680	0.03	0.008	0.078	0.016
786	MM	L	0-15	15.70	0.040	0.081	0.0200	0.010	1.35	0.02	0.06	0.380	0.02	0.014	0.055	0.008
791	MM	U	0-15	13.30	0.008	0.081	0.0052	0.004	2.02	0.02	0.09	0.731	0.02	0.015	0.089	0.015
791	MM	M	0-15	11.20	0.008	0.065	0.0015	0.012	1.41	0.02	0.04	0.485	0.02	0.008	0.157	0.008
791	MM	L	0-15	15.90	0.008	0.026	0.0087	0.002	5.38	0.02	0.11	0.818	0.02	0.035	0.099	0.016
793	MM	U	0-15	10.30	0.008	0.069	0.0008	0.017	1.14	0.02	0.09	0.796	0.02	0.018	0.076	0.008
793	MM	M	0-15	8.97	0.008	0.062	0.0009	0.017	0.97	0.02	0.10	0.680	0.02	0.018	0.084	0.012
793	MM	L	0-15	10.90	0.008	0.066	0.0014	0.010	1.30	0.02	0.05	0.873	0.03	0.006	0.086	0.008
			Mean	21.28	0.0215	0.07	0.0259	0.0163	2.40	0.02	0.08	0.76	0.02	0.02	0.08	0.01
			Max	41.00	0.0500	0.11	0.1050	0.0400	5.43	0.02	0.11	1.03	0.05	0.04	0.16	0.02
			Min	8.97	0.0080	0.03	0.0008	0.0020	0.70	0.02	0.04	0.38	0.02	0.01	0.04	0.01
			SD	12.17	0.0172	0.02	0.0343	0.0117	1.61	0.00	0.02	0.18	0.01	0.01	0.03	0.00
			CV (%)	57.17	80.34	31.14	132.63	71.76	67.09	0.00	27.12	23.04	33.80	51.84	37.95	33.49
798	FG	U	0-15	13.80	0.008	0.056	0.0088	0.003	2.66	0.02	0.11	1.520	0.03	0.011	0.067	0.019
798	FG	M	0-15	12.80	0.008	0.068	0.0036	0.007	2.55	0.02	0.06	1.980	0.03	0.003	0.055	0.016
798	FG	L	0-15	14.20	0.008	0.061	0.0139	0.002	3.33	0.02	0.06	1.390	0.04	0.006	0.110	0.010
800	FG	U	0-15	12.40	0.040	0.055	0.0040	0.010	2.26	0.02	0.07	1.060	0.02	0.003	0.087	0.018
800	FG	M	0-15	12.70	0.058	0.059	0.0040	0.010	2.27	0.02	0.16	1.060	0.09	0.015	0.042	0.032
800	FG	L	0-15	13.50	0.040	0.081	0.0040	0.010	2.42	0.02	0.08	1.170	0.04	0.008	0.044	0.008
			Mean	13.23	0.0270	0.06	0.0064	0.0070	2.58	0.02	0.09	1.36	0.04	0.01	0.07	0.02
			Max	14.20	0.0580	0.08	0.0139	0.0100	3.33	0.02	0.16	1.98	0.09	0.02	0.11	0.03
			Min	12.40	0.0080	0.06	0.0036	0.0020	2.26	0.02	0.06	1.06	0.02	0.00	0.04	0.01
			SD	0.71	0.0218	0.01	0.0042	0.0037	0.40	0.00	0.04	0.35	0.02	0.00	0.03	0.01
			CV (%)	5.34	80.84	15.49	65.40	52.68	15.43	0.00	43.32	25.97	59.60	61.55	39.45	49.49

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
804	MG	U	0-15	10.60	0.008	0.063	0.0013	0.002	0.94	0.02	0.08	0.883	0.04	0.010	0.112	0.015
804	MG	M	0-15	10.70	0.008	0.061	0.0008	0.004	0.53	0.02	0.06	0.768	0.02	0.010	0.103	0.010
804	MG	L	0-15	13.80	0.008	0.065	0.0045	0.004	1.74	0.02	0.09	1.070	0.06	0.010	0.083	0.008
806	MG	U	0-15	15.30	0.008	0.051	0.0008	0.004	0.48	0.02	0.10	0.666	0.03	0.006	0.188	0.010
806	MG	M	0-15	12.50	0.008	0.056	0.0018	0.002	1.00	0.02	0.24	0.630	0.04	0.028	0.076	0.041
806	MG	L	0-15	17.40	0.008	0.063	0.0047	0.002	1.66	0.02	0.11	0.715	0.05	0.020	0.061	0.015
809	MG	U	0-15	10.50	0.008	0.064	0.0011	0.042	0.49	0.02	0.07	0.739	0.04	0.003	0.161	0.008
809	MG	M	0-15	10.60	0.016	0.050	0.0020	0.004	0.55	0.02	0.09	0.886	0.04	0.008	0.123	0.022
809	MG	L	0-15	10.90	0.008	0.061	0.0049	0.005	1.06	0.02	0.07	0.706	0.06	0.006	0.080	0.012
812	MG	U	0-15	18.20	0.008	0.051	0.0008	0.002	0.37	0.02	0.04	0.604	0.02	0.007	0.163	0.019
812	MG	M	0-15	17.70	0.008	0.051	0.0008	0.004	0.51	0.02	0.05	0.685	0.02	0.004	0.152	0.016
812	MG	L	0-15	20.10	0.008	0.052	0.0008	0.015	0.61	0.02	0.05	0.754	0.05	0.006	0.224	0.008
815	MG	U	0-15	10.20	0.008	0.060	0.0008	0.034	0.46	0.02	0.06	0.814	0.03	0.005	0.206	0.008
815	MG	M	0-15	9.46	0.008	0.062	0.0008	0.041	0.45	0.02	0.10	0.746	0.06	0.008	0.157	0.012
815	MG	L	0-15	17.60	0.016	0.058	0.0044	0.029	4.02	0.02	0.10	0.948	0.09	0.017	0.151	0.012
823	MG	U	0-15	25.60	0.008	0.058	0.0016	0.046	0.89	0.02	0.07	0.605	0.07	0.012	0.195	0.012
823	MG	M	0-15	21.50	0.008	0.063	0.0038	0.038	1.39	0.02	0.06	0.666	0.06	0.012	0.165	0.008
823	MG	L	0-15	21.00	0.008	0.058	0.0045	0.022	1.53	0.02	0.12	0.721	0.07	0.015	0.140	0.033
1828	MG	U	0-15	7.52	0.008	0.058	0.0015	0.024	0.15	0.02	0.06	0.630	0.04	0.004	0.156	0.016
1828	MG	M	0-15	10.60	0.008	0.062	0.0037	0.015	1.06	0.02	0.08	0.788	0.07	0.007	0.106	0.022
1828	MG	L	0-15	9.14	0.008	0.060	0.0025	0.022	0.49	0.02	0.10	0.863	0.07	0.003	0.135	0.034
2828	MG	U	0-15	15.30	0.008	0.046	0.0035	0.007	0.64	0.02	0.09	0.546	0.06	0.011	0.091	0.025
2828	MG	M	0-15	15.10	0.008	0.056	0.0024	0.009	0.70	0.02	0.07	0.480	0.03	0.003	0.091	0.011
2828	MG	L	0-15	14.80	0.008	0.051	0.0028	0.012	0.72	0.02	0.06	0.547	0.05	0.003	0.123	0.016
			Mean	14.42	0.0087	0.06	0.0024	0.0162	0.93	0.02	0.08	0.73	0.05	0.01	0.14	0.02
			Max	25.60	0.0160	0.07	0.0049	0.0460	4.02	0.02	0.24	1.07	0.09	0.03	0.22	0.04
			Min	7.52	0.0080	0.05	0.0008	0.0020	0.15	0.02	0.04	0.48	0.02	0.00	0.06	0.01
			SD	4.68	0.0023	0.01	0.0015	0.0149	0.78	0.00	0.04	0.14	0.02	0.01	0.04	0.01
			CV (%)	32.47	26.06	9.32	63.84	91.75	83.72	0.00	46.60	18.87	38.41	67.08	32.55	55.21

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
586	PL	U	0-15	0.015	0.102	76.6	0.116	0.7
586	PL	M	0-15	0.022	0.142	195.0	0.246	1.0
586	PL	L	0-15	0.012	0.102	86.5	0.118	0.7
588	PL	U	0-15	0.036	0.050	81.2	0.054	0.4
588	PL	M	0-15	0.057	0.072	73.7	0.045	0.4
588	PL	L	0-15	0.012	0.067	72.4	0.056	0.3
590	PL	U	0-15	0.058	0.027	41.0	0.027	0.2
590	PL	M	0-15	0.009	0.070	124.0	0.124	0.2
590	PL	L	0-15	0.004	0.067	88.6	0.080	0.2
591	PL	U	0-15	0.004	0.110	93.9	0.060	0.5
591	PL	M	0-15	0.026	0.138	49.7	0.037	0.8
591	PL	L	0-15	0.020	0.205	149.0	0.108	0.8
592	PL	U	0-15	0.080	0.088	116.0	0.061	0.7
592	PL	M	0-15	0.073	0.091	127.0	0.051	0.8
592	PL	L	0-15	0.081	0.089	139.0	0.045	0.8
593	PL	U	0-15	0.008	0.072	256.0	0.215	1.0
593	PL	M	0-15	0.005	0.101	147.0	0.111	0.8
593	PL	L	0-15	0.008	0.075	115.0	0.061	0.5
594	PL	U	0-15	0.004	0.038	62.2	0.035	0.4
594	PL	M	0-15	0.004	0.035	357.0	0.314	0.3
594	PL	L	0-15	0.004	0.058	71.8	0.039	0.3
595	PL	U	0-15	0.008	0.074	154.0	0.092	1.0
595	PL	M	0-15	0.007	0.058	125.0	0.121	0.8
595	PL	L	0-15	0.004	0.067	115.0	0.089	0.7
599	PL	U	0-15	0.008	0.080	125.0	0.073	1.2
599	PL	M	0-15	0.008	0.055	858.0	0.623	1.4
599	PL	L	0-15	0.008	0.094	357.0	0.303	1.6
			Mean	0.02	0.08	157.65	0.12	0.69
			Max	0.08	0.21	858.00	0.62	1.60
			Min	0.00	0.03	41.00	0.03	0.20
			SD	0.02	0.04	160.95	0.13	0.36
			CV (%)	115.32	44.69	102.09	103.75	53.20

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
615	MB	U	0-15	0.153	0.044	223.0	0.394	0.3
615	MB	M	0-15	0.004	0.040	428.0	0.495	0.4
615	MB	L	0-15	0.044	0.108	52.6	0.099	0.8
			Mean	0.07	0.06	234.53	0.33	0.50
			Max	0.15	0.11	428.00	0.50	0.80
			Min	0.00	0.04	52.60	0.10	0.30
			SD	0.08	0.04	187.97	0.21	0.26
			CV (%)	115.10	59.62	80.14	62.48	52.92
678	BT	U	0-15	0.004	0.042	77.4	0.055	0.5
678	BT	M	0-15	0.004	0.050	76.1	0.090	1.1
678	BT	L	0-15	0.006	0.059	108.0	0.063	0.8
680	BT	U	0-15	0.004	0.040	72.5	0.047	0.3
680	BT	M	0-15	0.004	0.052	69.9	0.042	0.3
680	BT	L	0-15	0.004	0.031	218.0	0.140	0.5
681	BT	U	0-15	0.004	0.022	418.0	0.290	0.2
681	BT	M	0-15	0.004	0.052	53.6	0.037	0.2
681	BT	L	0-15	0.004	0.038	207.0	0.126	0.3
684	BT	U	0-15	0.014	0.055	59.1	0.089	0.2
684	BT	M	0-15	0.004	0.054	246.0	0.216	0.2
684	BT	L	0-15	0.020	0.065	50.5	0.058	0.2
687	BT	U	0-15	0.008	0.071	45.8	0.039	0.1
687	BT	M	0-15	0.012	0.058	47.1	0.054	0.2
687	BT	L	0-15	0.024	0.082	227.0	0.142	0.4
688	BT	U	0-15	0.010	0.042	66.6	0.037	0.4
688	BT	M	0-15	0.010	0.070	202.0	0.159	0.4
688	BT	L	0-15	0.014	0.069	89.2	0.087	0.3
692	BT	U	0-15	0.015	0.105	89.8	0.134	0.3
692	BT	M	0-15	0.011	0.050	73.8	0.093	0.4
692	BT	L	0-15	0.011	0.056	79.5	0.078	0.5
703	BT	U	0-15	0.012	0.069	90.1	0.074	0.3
703	BT	M	0-15	0.014	0.053	110.0	0.079	0.2
703	BT	L	0-15	0.098	0.157	23.2	0.080	1.2
			Mean	0.01	0.06	116.68	0.10	0.40
			Max	0.10	0.16	418.00	0.29	1.20
			Min	0.00	0.02	23.20	0.04	0.10
			SD	0.02	0.03	91.14	0.06	0.28
			CV (%)	144.15	44.72	78.11	63.35	69.68

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
727	AP	U	0-15	0.028	0.079	81.8	0.101	0.7
727	AP	M	0-15	0.008	0.051	89.1	0.037	0.8
727	AP	L	0-15	0.013	0.091	82.9	0.069	0.6
728	AP	U	0-15	0.016	0.066	130.0	0.235	0.4
728	AP	M	0-15	0.016	0.054	87.1	0.083	0.5
728	AP	L	0-15	0.029	0.072	86.6	0.213	0.5
730	AP	U	0-15	0.033	0.087	11.7	0.132	0.3
730	AP	M	0-15	0.011	0.086	296.0	0.252	0.4
730	AP	L	0-15	0.034	0.086	182.0	0.169	0.4
738	AP	U	0-15	0.011	0.065	68.4	0.149	0.5
738	AP	M	0-15	0.011	0.056	109.0	0.155	0.5
738	AP	L	0-15	0.011	0.080	85.6	0.082	0.6
739	AP	U	0-15	0.016	0.112	112.0	0.149	0.2
739	AP	M	0-15	0.014	0.072	45.8	0.065	0.2
739	AP	L	0-15	0.011	0.081	66.2	0.103	0.2
740	AP	U	0-15	0.013	0.104	161.0	0.253	0.5
740	AP	M	0-15	0.017	0.068	63.8	0.208	0.4
740	AP	L	0-15	0.144	0.087	68.4	0.036	0.8
743	AP	U	0-15	0.042	0.068	30.2	0.019	0.4
743	AP	M	0-15	0.012	0.079	90.8	0.054	0.6
743	AP	L	0-15	0.015	0.117	408.0	0.381	0.7
744	AP	U	0-15	0.009	0.056	70.1	0.089	0.5
744	AP	M	0-15	0.010	0.052	68.4	0.097	0.5
744	AP	L	0-15	0.014	0.106	291.0	0.295	0.5
746	AP	U	0-15	0.022	0.056	73.3	0.172	0.5
746	AP	M	0-15	0.016	0.076	276.0	0.212	0.5
746	AP	L	0-15	0.011	0.061	112.0	0.049	0.6
			Mean	0.02	0.08	120.27	0.14	0.49
			Max	0.14	0.12	408.00	0.38	0.80
			Min	0.01	0.05	11.70	0.02	0.20
			SD	0.03	0.02	93.11	0.09	0.16
			CV (%)	119.25	24.11	77.42	62.88	32.31

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
769	MM	U	0-15	0.008	0.091	165.0	0.122	0.4
769	MM	M	0-15	0.009	0.064	94.9	0.205	0.3
769	MM	L	0-15	0.010	0.068	145.0	0.186	0.3
781	MM	U	0-15	0.007	0.075	107.0	0.145	0.7
781	MM	M	0-15	0.008	0.070	109.0	0.080	1.1
781	MM	L	0-15	0.008	0.086	106.0	0.092	1.4
786	MM	U	0-15	0.029	0.150	78.5	0.063	0.3
786	MM	M	0-15	0.036	0.104	135.0	0.087	0.2
786	MM	L	0-15	0.010	0.043	54.8	0.064	0.2
791	MM	U	0-15	0.012	0.094	183.0	0.125	0.2
791	MM	M	0-15	0.086	0.111	42.6	0.022	0.3
791	MM	L	0-15	0.022	0.134	236.0	0.263	0.2
793	MM	U	0-15	0.057	0.074	135.0	0.090	0.3
793	MM	M	0-15	0.053	0.076	182.0	0.146	0.2
793	MM	L	0-15	0.019	0.059	126.0	0.069	0.3
			Mean	0.02	0.09	126.65	0.12	0.43
			Max	0.09	0.15	236.00	0.26	1.40
			Min	0.01	0.04	42.60	0.02	0.20
			SD	0.02	0.03	51.28	0.06	0.36
			CV (%)	94.53	33.01	40.49	54.03	84.72
798	FG	U	0-15	0.015	0.062	171.0	0.118	0.4
798	FG	M	0-15	0.034	0.048	75.0	0.022	0.5
798	FG	L	0-15	0.016	0.056	98.2	0.079	0.5
800	FG	U	0-15	0.012	0.066	134.0	0.029	0.5
800	FG	M	0-15	0.012	0.093	279.0	0.207	0.5
800	FG	L	0-15	0.017	0.090	138.0	0.057	0.5
			Mean	0.02	0.07	149.20	0.09	0.48
			Max	0.03	0.09	279.00	0.21	0.50
			Min	0.01	0.05	75.00	0.02	0.40
			SD	0.01	0.02	71.81	0.07	0.04
			CV (%)	46.77	26.54	48.13	81.02	8.45

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 3. Results of micronutrient analysis from 42 benchmark sites across Alberta (0-15 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
804	MG	U	0-15	0.015	0.130	122.0	0.088	0.3
804	MG	M	0-15	0.038	0.114	101.0	0.042	0.4
804	MG	L	0-15	0.048	0.184	98.6	0.094	0.5
806	MG	U	0-15	0.079	0.128	39.5	0.051	0.5
806	MG	M	0-15	0.019	0.154	446.0	0.470	0.5
806	MG	L	0-15	0.010	0.070	221.0	0.178	0.5
809	MG	U	0-15	0.073	0.073	63.7	0.018	0.3
809	MG	M	0-15	0.023	0.139	140.0	0.080	0.4
809	MG	L	0-15	0.021	0.070	153.0	0.092	0.3
812	MG	U	0-15	0.109	0.112	39.1	0.012	0.3
812	MG	M	0-15	0.106	0.098	42.0	0.016	0.2
812	MG	L	0-15	0.116	0.135	49.4	0.030	0.4
815	MG	U	0-15	0.050	0.086	79.9	0.034	0.4
815	MG	M	0-15	0.050	0.090	108.0	0.039	0.3
815	MG	L	0-15	0.037	0.181	139.0	0.092	0.4
823	MG	U	0-15	0.074	0.106	86.5	0.008	0.2
823	MG	M	0-15	0.080	0.123	139.0	0.024	0.3
823	MG	L	0-15	0.066	0.136	260.0	0.229	0.3
1828	MG	U	0-15	0.037	0.054	61.2	0.020	0.2
1828	MG	M	0-15	0.052	0.091	173.0	0.116	0.2
1828	MG	L	0-15	0.042	0.094	179.0	0.080	0.3
2828	MG	U	0-15	0.021	0.110	185.0	0.133	0.3
2828	MG	M	0-15	0.021	0.091	113.0	0.036	0.4
2828	MG	L	0-15	0.028	0.103	108.0	0.036	0.4
			Mean	0.05	0.11	131.12	0.08	0.35
			Max	0.12	0.18	446.00	0.47	0.50
			Min	0.01	0.05	39.10	0.01	0.20
			SD	0.03	0.03	88.57	0.10	0.10
			CV (%)	61.29	29.81	67.55	117.65	28.25

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth).

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
586	PL	U	15-30	18.30	0.03	0.02	0.10	2.81	0.002	0.03	0.213	0.015	0.011	0.045	2.670
586	PL	M	15-30	12.90	0.02	0.01	0.05	2.36	0.001	0.02	0.296	0.036	0.008	0.029	2.780
586	PL	L	15-30	16.60	0.28	0.01	0.07	1.85	0.001	0.03	0.200	0.093	0.007	0.059	2.210
588	PL	U	15-30	3.30	0.02	0.01	0.05	1.05	0.001	0.01	0.289	0.022	0.010	0.030	1.430
588	PL	M	15-30	3.90	0.15	0.01	0.06	1.33	0.001	0.02	0.193	0.099	0.008	0.100	1.970
588	PL	L	15-30	21.20	5.54	0.01	0.04	2.44	0.001	0.01	0.189	0.102	0.010	0.136	0.538
590	PL	U	15-30	7.20	0.33	0.01	0.05	2.73	0.001	0.01	0.230	0.004	0.007	0.169	0.495
590	PL	M	15-30	3.80	0.67	0.01	0.07	3.04	0.001	0.01	0.146	0.018	0.009	0.025	0.821
590	PL	L	15-30	2.80	0.98	0.01	0.09	3.34	0.001	0.02	0.146	0.017	0.008	0.023	1.060
591	PL	U	15-30	2.00	0.73	0.01	0.06	1.54	0.001	0.02	0.184	0.011	0.007	0.050	1.820
591	PL	M	15-30	18.10	0.02	0.01	0.06	3.32	0.001	0.02	0.287	0.049	0.006	0.063	2.150
591	PL	L	15-30	10.60	0.98	0.02	0.10	1.94	0.002	0.04	0.302	0.634	0.011	0.392	2.900
592	PL	U	15-30	26.80	0.02	0.01	0.02	3.80	0.001	0.02	0.141	0.065	0.007	0.019	3.200
592	PL	M	15-30	11.40	0.02	0.01	0.04	3.79	0.001	0.02	0.162	0.087	0.007	0.021	3.170
592	PL	L	15-30	13.40	0.03	0.02	0.06	3.42	0.002	0.04	0.235	0.491	0.011	0.051	1.160
593	PL	U	15-30	4.00	13.80	0.01	0.12	0.75	0.001	0.01	0.267	0.036	0.011	0.124	3.420
593	PL	M	15-30	5.20	0.84	0.01	0.15	1.73	0.001	0.01	0.214	0.038	0.007	0.071	4.220
593	PL	L	15-30	9.80	2.13	0.02	0.15	1.35	0.002	0.03	0.184	0.013	0.005	0.199	4.720
594	PL	U	15-30	14.20	48.20	0.01	0.08	0.96	0.001	0.01	0.708	0.024	0.008	0.136	2.250
594	PL	M	15-30	6.40	18.20	0.01	0.10	1.34	0.001	0.01	0.628	0.012	0.006	0.119	2.420
594	PL	L	15-30	9.00	5.16	0.01	0.06	1.49	0.001	0.01	0.818	0.030	0.006	0.096	2.310
595	PL	U	15-30	7.50	1.90	0.02	0.23	1.17	0.002	0.03	0.450	0.066	0.009	0.080	4.120
595	PL	M	15-30	7.20	21.40	0.01	0.13	0.59	0.001	0.01	1.300	0.052	0.010	0.128	2.260
595	PL	L	15-30	9.20	7.90	0.02	0.17	0.69	0.002	0.03	0.287	0.015	0.009	0.165	3.100
599	PL	U	15-30	8.30	5.34	0.02	0.20	1.14	0.002	0.03	1.870	0.118	0.009	0.090	3.000
599	PL	M	15-30	10.60	2.93	0.02	0.13	1.16	0.002	0.03	1.580	0.121	0.005	0.073	2.830
599	PL	L	15-30	9.40	2.03	0.02	0.15	1.26	0.002	0.03	2.130	0.147	0.008	0.054	2.200
			Mean	10.11	5.17	0.01	0.10	1.94	0.001	0.02	0.51	0.09	0.01	0.09	2.42
			Max	26.80	48.20	0.02	0.23	3.80	0.002	0.04	2.13	0.63	0.01	0.39	4.72
			Min	2.00	0.02	0.01	0.02	0.59	0.001	0.01	0.14	0.00	0.01	0.02	0.50
			SD	6.08	10.29	0.005	0.05	1.01	0.0005	0.01	0.56	0.14	0.002	0.08	1.07
			CV (%)	60.10	198.97	36.03	55.03	51.87	36.03	48.08	110.10	160.35	22.50	82.37	44.46

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
615	MB	U	15-30	7.80	1.46	0.01	0.03	2.07	0.001	0.01	1.590	0.129	0.012	0.044	0.803
615	MB	M	15-30	4.50	5.02	0.01	0.04	1.93	0.001	0.01	1.310	0.103	0.009	0.086	0.677
615	MB	L	15-30	6.30	0.42	0.01	0.04	2.13	0.001	0.01	1.550	0.225	0.006	0.153	1.500
			Mean	6.20	2.30	0.01	0.04	2.04	0.001	0.01	1.48	0.15	0.01	0.09	0.99
			Max	7.80	5.02	0.01	0.04	2.13	0.001	0.01	1.59	0.23	0.01	0.15	1.50
			Min	4.50	0.42	0.01	0.03	1.93	0.001	0.01	1.31	0.10	0.01	0.04	0.68
			SD	1.65	2.41	0.00	0.01	0.10	0.000	0.00	0.15	0.06	0.003	0.05	0.44
			CV (%)	26.65	104.88	0.00	15.75	5.02	0.00	0.00	10.21	42.18	33.33	58.28	44.63
678	BT	U	15-30	8.9	16.40	0.01	0.10	1.00	0.001	0.01	1.540	0.032	0.008	0.107	1.05
678	BT	M	15-30	12.9	27.70	0.01	0.06	1.21	0.001	0.01	1.420	0.083	0.010	0.121	1.04
678	BT	L	15-30	8.7	1.13	0.01	0.07	1.34	0.001	0.01	1.550	0.092	0.007	0.066	1.09
680	BT	U	15-30	8.0	2.41	0.01	0.09	1.01	0.001	0.01	1.610	0.007	0.007	0.057	0.45
680	BT	M	15-30	3.6	11.20	0.01	0.11	1.20	0.001	0.01	1.690	0.042	0.008	0.046	0.73
680	BT	L	15-30	7.0	3.14	0.01	0.05	1.33	0.001	0.02	1.460	0.048	0.007	0.050	0.68
681	BT	U	15-30	4.7	1.46	0.01	0.07	1.27	0.001	0.01	1.230	0.036	0.007	0.059	0.49
681	BT	M	15-30	3.0	2.30	0.01	0.07	1.23	0.001	0.01	1.600	0.025	0.007	0.066	0.44
681	BT	L	15-30	2.30	1.07	0.01	0.07	1.05	0.001	0.02	0.734	0.055	0.007	0.067	0.527
684	BT	U	15-30	8.20	0.38	0.01	0.11	3.32	0.001	0.01	1.340	0.013	0.006	0.049	1.050
684	BT	M	15-30	6.20	2.21	0.01	0.07	3.31	0.001	0.01	1.240	0.030	0.008	0.068	0.693
684	BT	L	15-30	12.20	9.21	0.01	0.04	4.65	0.001	0.01	1.150	0.198	0.006	0.105	0.655
687	BT	U	15-30	19.50	2.85	0.01	0.07	1.74	0.001	0.01	1.020	0.014	0.007	0.058	0.467
687	BT	M	15-30	10.30	3.26	0.01	0.03	1.69	0.001	0.01	0.878	0.025	0.008	0.052	0.334
687	BT	L	15-30	19.10	0.09	0.01	0.06	1.99	0.001	0.01	1.090	0.063	0.009	0.066	0.674
688	BT	U	15-30	2.40	12.20	0.01	0.15	2.23	0.001	0.01	1.310	0.057	0.009	0.073	1.070
688	BT	M	15-30	1.40	20.00	0.01	0.16	3.47	0.001	0.01	0.857	0.100	0.009	0.134	1.310
688	BT	L	15-30	2.50	10.70	0.01	0.12	3.43	0.001	0.01	1.060	0.126	0.009	0.205	1.130
692	BT	U	15-30	8.30	18.40	0.05	0.25	3.38	0.005	0.07	2.060	0.016	0.011	0.186	3.280
692	BT	M	15-30	6.80	10.80	0.02	0.11	1.65	0.002	0.03	2.330	0.036	0.010	0.155	2.800
692	BT	L	15-30	4.50	0.43	0.02	0.14	3.73	0.002	0.03	2.210	0.050	0.007	0.277	0.519
703	BT	U	15-30	7.80	2.65	0.02	0.14	2.94	0.002	0.03	1.110	0.015	0.014	0.092	0.586
703	BT	M	15-30	5.50	6.31	0.02	0.13	2.73	0.002	0.03	1.270	0.016	0.011	0.076	0.528
703	BT	L	15-30	2.10	0.02	0.01	0.08	3.97	0.001	0.01	1.030	0.048	0.007	0.215	3.060
			Mean	7.33	6.93	0.01	0.10	2.29	0.001	0.02	1.37	0.05	0.01	0.10	1.03
			Max	19.50	27.70	0.05	0.25	4.65	0.005	0.07	2.33	0.20	0.01	0.28	3.28
			Min	1.40	0.02	0.01	0.03	1.00	0.001	0.01	0.73	0.01	0.01	0.05	0.33
			SD	4.87	7.54	0.01	0.05	1.13	0.001	0.01	0.41	0.04	0.002	0.06	0.83
			CV (%)	66.42	108.85	65.11	49.21	49.46	65.11	82.36	30.05	85.29	22.63	61.32	80.55

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
727	AP	U	15-30	32.00	2.32	0.05	0.26	6.11	0.005	0.07	1.930	0.210	0.017	0.253	1.550
727	AP	M	15-30	9.30	30.20	0.02	0.17	3.63	0.002	0.03	1.400	0.168	0.013	0.235	1.350
727	AP	L	15-30	5.00	19.50	0.02	0.19	3.16	0.002	0.03	1.730	0.195	0.015	0.419	1.540
728	AP	U	15-30	5.80	8.41	0.05	0.10	0.76	0.005	0.07	0.816	0.038	0.009	0.053	0.305
728	AP	M	15-30	13.00	1.42	0.02	0.11	1.78	0.002	0.03	0.875	0.074	0.013	0.072	0.457
728	AP	L	15-30	16.20	4.13	0.05	0.10	2.35	0.005	0.07	1.330	0.160	0.008	0.075	1.040
730	AP	U	15-30	5.10	0.29	0.02	0.07	1.68	0.002	0.03	1.330	0.028	0.008	0.040	1.310
730	AP	M	15-30	5.00	9.19	0.05	0.10	1.76	0.005	0.07	1.300	0.031	0.009	0.064	0.846
730	AP	L	15-30	5.00	0.64	0.01	0.06	1.19	0.001	0.01	0.783	0.080	0.008	0.068	0.816
738	AP	U	15-30	14.80	4.64	0.02	0.09	3.51	0.002	0.03	0.707	0.120	0.008	0.211	1.230
738	AP	M	15-30	10.10	47.60	0.02	0.24	1.36	0.002	0.03	0.657	0.108	0.009	0.204	0.586
738	AP	L	15-30	10.60	42.80	0.05	0.23	1.32	0.005	0.07	0.908	0.180	0.008	0.238	0.433
739	AP	U	15-30	2.40	0.03	0.02	0.09	4.63	0.002	0.03	0.692	0.057	0.007	0.066	0.544
739	AP	M	15-30	3.20	0.75	0.01	0.09	2.64	0.001	0.01	0.470	0.047	0.007	0.058	0.354
739	AP	L	15-30	2.00	2.26	0.02	0.05	2.35	0.002	0.03	0.872	0.048	0.004	0.079	0.309
740	AP	U	15-30	8.10	3.77	0.02	0.16	3.74	0.002	0.03	0.936	0.044	0.007	0.117	1.070
740	AP	M	15-30	8.60	5.55	0.02	0.12	3.13	0.002	0.03	0.799	0.097	0.008	0.129	0.493
740	AP	L	15-30	5.10	0.03	0.02	0.08	0.26	0.002	0.03	1.190	0.133	0.006	0.092	1.360
743	AP	U	15-30	1.20	0.06	0.02	0.04	4.10	0.002	0.03	0.819	0.027	0.006	0.069	1.790
743	AP	M	15-30	3.40	0.03	0.02	0.19	3.64	0.002	0.03	0.959	0.115	0.008	0.114	2.490
743	AP	L	15-30	3.70	37.10	0.02	0.19	2.50	0.002	0.03	0.448	0.146	0.008	0.234	0.891
744	AP	U	15-30	31.30	7.08	0.02	0.11	3.39	0.002	0.03	1.010	0.061	0.008	0.108	0.671
744	AP	M	15-30	15.30	5.42	0.01	0.12	3.01	0.001	0.01	0.577	0.074	0.007	0.102	0.723
744	AP	L	15-30	14.30	5.91	0.02	0.11	3.65	0.002	0.03	0.478	0.160	0.007	0.127	1.290
746	AP	U	15-30	3.10	0.05	0.02	0.08	3.32	0.002	0.03	0.777	0.152	0.007	0.081	0.805
746	AP	M	15-30	2.80	3.51	0.02	0.12	3.03	0.002	0.03	0.593	0.116	0.007	0.085	0.701
746	AP	L	15-30	2.10	27.00	0.02	0.14	3.21	0.002	0.03	0.637	0.149	0.008	0.182	0.815
			Mean	8.83	9.99	0.02	0.13	2.79	0.002	0.04	0.93	0.10	0.01	0.13	0.95
			Max	32.00	47.60	0.05	0.26	6.11	0.005	0.07	1.93	0.21	0.02	0.42	2.49
			Min	1.20	0.03	0.01	0.04	0.26	0.001	0.01	0.45	0.03	0.004	0.04	0.31
			SD	7.98	14.12	0.01	0.06	1.27	0.001	0.02	0.37	0.06	0.003	0.09	0.52
			CV (%)	90.34	141.32	52.41	46.33	45.62	52.41	51.31	40.37	53.47	33.10	66.00	54.06

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
769	MM	U	15-30	3.40	13.80	0.01	0.11	2.12	0.001	0.01	0.750	0.072	0.008	0.147	0.656
769	MM	M	15-30	4.30	46.30	0.01	0.10	2.22	0.001	0.16	0.374	0.223	0.009	0.152	0.677
769	MM	L	15-30	10.30	80.50	0.05	0.10	2.05	0.005	0.12	0.004	0.131	0.008	0.246	0.539
781	MM	U	15-30	8.20	48.60	0.04	0.08	3.33	0.004	0.06	0.004	0.125	0.008	0.231	1.230
781	MM	M	15-30	9.80	37.90	0.05	0.10	3.43	0.005	0.07	0.004	0.161	0.015	0.226	1.200
781	MM	L	15-30	11.80	50.70	0.02	0.11	1.67	0.002	0.03	0.655	0.133	0.014	0.382	1.540
786	MM	U	15-30	2.50	0.02	0.01	0.06	4.50	0.001	0.01	1.010	0.047	0.008	0.039	0.768
786	MM	M	15-30	2.40	0.17	0.01	0.04	4.84	0.001	0.01	0.717	0.065	0.008	0.044	0.421
786	MM	L	15-30	1.70	33.10	0.05	0.10	2.12	0.005	0.07	0.354	0.065	0.010	0.140	0.336
791	MM	U	15-30	2.20	0.02	0.01	0.09	5.00	0.001	0.01	0.458	0.092	0.007	0.108	1.280
791	MM	M	15-30	2.80	0.06	0.01	0.03	6.49	0.001	0.01	0.783	0.072	0.008	0.042	1.840
791	MM	L	15-30	3.20	2.54	0.01	0.10	5.78	0.001	0.01	0.232	0.345	0.006	0.175	2.520
793	MM	U	15-30	3.20	0.02	0.01	0.05	4.54	0.001	0.01	0.423	0.135	0.007	0.053	0.855
793	MM	M	15-30	3.70	0.05	0.01	0.04	3.74	0.001	0.01	0.566	0.088	0.008	0.034	1.050
793	MM	L	15-30	3.20	0.49	0.01	0.08	3.43	0.001	0.01	0.477	0.116	0.007	0.066	1.080
			Mean	4.85	20.95	0.02	0.08	3.68	0.002	0.04	0.45	0.12	0.01	0.14	1.07
			Max	11.80	80.50	0.05	0.11	6.49	0.005	0.16	1.01	0.35	0.02	0.38	2.52
			Min	1.70	0.02	0.01	0.03	1.67	0.001	0.01	0.004	0.05	0.01	0.03	0.34
			SD	3.36	26.32	0.02	0.03	1.48	0.002	0.05	0.30	0.08	0.003	0.10	0.58
			CV (%)	69.38	125.64	82.74	35.16	40.23	82.74	118.02	67.16	60.99	28.86	72.25	54.40
798	FG	U	15-30	14.00	2.30	0.01	0.11	3.23	0.001	0.01	0.659	0.171	0.008	0.090	0.720
798	FG	M	15-30	22.40	0.81	0.01	0.08	3.00	0.001	0.01	0.401	0.149	0.006	0.074	0.671
798	FG	L	15-30	15.30	11.30	0.05	0.10	3.18	0.005	0.07	0.506	0.142	0.009	0.118	0.931
800	FG	U	15-30	5.00	2.13	0.05	0.13	4.93	0.005	0.07	0.933	0.250	0.009	0.244	2.560
800	FG	M	15-30	4.20	4.08	0.05	0.10	4.92	0.005	0.07	0.442	0.245	0.010	0.280	2.710
800	FG	L	15-30	8.70	0.96	0.05	0.10	4.83	0.005	0.07	0.958	0.269	0.008	0.215	2.610
			Mean	11.60	3.60	0.04	0.10	4.02	0.004	0.05	0.65	0.20	0.01	0.17	1.70
			Max	22.40	11.30	0.05	0.13	4.93	0.005	0.07	0.96	0.27	0.01	0.28	2.71
			Min	4.20	0.81	0.01	0.08	3.00	0.001	0.01	0.40	0.14	0.01	0.07	0.67
			SD	6.97	3.95	0.02	0.02	0.97	0.002	0.03	0.25	0.06	0.001	0.09	1.02
			CV (%)	60.08	109.90	56.33	15.80	24.06	56.33	61.97	37.76	27.67	16.40	51.18	59.97

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Chloride ¹ (mg/kg) (0.5) ⁵	Aluminum ² (mg/kg) (0.02) ⁵	Antimony ² (mg/kg) (0.01) ⁵	Arsenic ² (mg/kg) (0.02) ⁵	Barium ² (mg/kg) (0.0004) ⁵	Beryllium ² (mg/kg) (0.001) ⁵	Bismuth ² (mg/kg) (0.01) ⁵	Boron ² (mg/kg) (0.004) ⁵	Cadmium ² (mg/kg) (0.001) ⁵	Chromium ² (mg/kg) (0.002) ⁵	Cobalt ² (mg/kg) (0.001) ⁵	Copper ² (mg/kg) (0.002) ⁵
804	MG	U	15-30	2.60	0.76	0.01	0.06	3.21	0.001	0.01	0.628	0.055	0.007	0.097	0.690
804	MG	M	15-30	3.80	0.08	0.01	0.06	2.97	0.001	0.01	0.277	0.052	0.007	0.082	0.711
804	MG	L	15-30	4.20	1.16	0.01	0.08	2.69	0.001	0.01	0.326	0.099	0.007	0.105	1.050
806	MG	U	15-30	10.40	0.16	0.01	0.04	2.85	0.001	0.01	0.363	0.042	0.008	0.075	0.986
806	MG	M	15-30	6.50	0.70	0.01	0.06	2.06	0.001	0.01	0.201	0.068	0.007	0.128	0.817
806	MG	L	15-30	8.20	6.22	0.01	0.15	2.58	0.001	0.01	0.386	0.096	0.006	0.138	1.050
809	MG	U	15-30	2.80	0.02	0.01	0.08	2.88	0.001	0.01	0.603	0.086	0.009	0.060	1.630
809	MG	M	15-30	3.00	0.02	0.01	0.11	3.11	0.001	0.01	0.386	0.082	0.007	0.085	1.900
809	MG	L	15-30	3.50	0.15	0.01	0.17	3.02	0.001	0.01	0.451	0.073	0.007	0.078	0.818
812	MG	U	15-30	7.90	0.02	0.01	0.02	2.01	0.001	0.01	0.457	0.036	0.007	0.109	1.440
812	MG	M	15-30	9.50	0.02	0.01	0.02	1.26	0.001	0.01	0.669	0.030	0.007	0.091	1.320
812	MG	L	15-30	12.10	0.02	0.01	0.03	1.87	0.001	0.01	0.609	0.047	0.009	0.097	1.730
815	MG	U	15-30	4.40	0.11	0.01	0.03	4.56	0.001	0.01	0.738	0.037	0.008	0.041	1.170
815	MG	M	15-30	3.80	0.02	0.01	0.05	4.31	0.001	0.01	0.753	0.051	0.009	0.062	1.390
815	MG	L	15-30	2.70	0.02	0.01	0.19	3.01	0.001	0.01	0.563	0.157	0.006	0.118	2.400
823	MG	U	15-30	24.70	0.15	0.01	0.03	1.86	0.001	0.01	0.137	0.076	0.009	0.113	1.070
823	MG	M	15-30	17.10	0.02	0.01	0.11	2.14	0.001	0.01	2.320	0.131	0.009	0.125	0.836
823	MG	L	15-30	31.10	0.02	0.01	0.11	1.70	0.001	0.01	1.560	0.171	0.009	0.133	0.818
1828	MG	U	15-30	1.40	0.15	0.01	0.02	3.89	0.001	0.01	1.550	0.026	0.008	0.042	0.889
1828	MG	M	15-30	6.20	0.12	0.02	0.10	4.01	0.002	0.03	4.100	0.057	0.008	0.110	1.610
1828	MG	L	15-30	1.60	0.02	0.01	0.13	4.54	0.001	0.01	1.710	0.077	0.008	0.136	1.150
2828	MG	U	15-30	3.10	0.02	0.01	0.10	4.27	0.001	0.01	1.740	0.069	0.007	0.088	1.980
2828	MG	M	15-30	5.00	0.06	0.01	0.13	4.01	0.001	0.01	1.450	0.094	0.008	0.178	1.780
2828	MG	L	15-30	5.70	0.02	0.01	0.12	4.19	0.001	0.01	1.970	0.083	0.008	0.165	2.130
			Mean	7.55	0.42	0.01	0.08	3.04	0.001	0.01	1.00	0.07	0.01	0.10	1.31
			Max	31.10	6.22	0.02	0.19	4.56	0.002	0.03	4.10	0.17	0.01	0.18	2.40
			Min	1.40	0.02	0.01	0.02	1.26	0.001	0.01	0.14	0.03	0.01	0.04	0.69
			SD	7.33	1.27	0.002	0.05	0.99	0.0002	0.004	0.91	0.04	0.001	0.03	0.49
			CV (%)	97.04	302.67	19.60	59.70	32.59	19.60	37.68	91.47	49.77	12.38	34.04	37.37

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
586	PL	U	15-30	100.0	0.738	0.107	279.0	2.36	0.008	1.25	0.58	0.060	2.96	0.004	5.29
586	PL	M	15-30	113.0	0.849	0.225	467.0	2.71	0.003	2.44	0.63	0.064	4.84	0.002	6.59
586	PL	L	15-30	156.0	0.754	0.174	388.0	3.82	0.002	1.50	1.10	0.064	5.38	0.002	4.89
588	PL	U	15-30	26.0	0.887	0.236	708.0	4.47	0.002	0.37	0.52	0.041	8.46	0.002	10.00
588	PL	M	15-30	137.0	1.620	0.081	364.0	5.11	0.003	1.37	0.98	0.067	6.13	0.002	5.45
588	PL	L	15-30	58.1	0.471	0.013	71.9	72.40	0.002	1.26	1.86	0.077	4.38	0.002	2.19
590	PL	U	15-30	24.0	0.333	0.012	173.0	2.62	0.002	0.81	0.46	0.033	3.41	0.002	3.50
590	PL	M	15-30	31.4	0.402	0.020	164.0	4.42	0.002	0.75	0.50	0.035	2.62	0.002	3.33
590	PL	L	15-30	49.7	0.473	0.014	202.0	3.70	0.002	0.97	0.49	0.044	2.23	0.002	3.58
591	PL	U	15-30	62.7	1.230	0.062	319.0	2.53	0.002	0.89	0.60	0.046	2.82	0.002	5.67
591	PL	M	15-30	37.8	1.300	0.213	350.0	1.92	0.002	1.59	0.45	0.040	7.12	0.002	7.27
591	PL	L	15-30	265.0	1.180	0.078	335.0	12.50	0.004	7.33	1.96	0.100	10.00	0.004	7.74
592	PL	U	15-30	67.1	1.130	0.236	465.0	3.44	0.004	1.20	0.81	0.035	20.80	0.002	6.51
592	PL	M	15-30	67.3	1.000	0.258	456.0	3.88	0.002	1.55	0.98	0.046	19.40	0.002	6.42
592	PL	L	15-30	91.2	1.290	0.191	383.0	8.95	0.016	2.12	2.15	0.083	23.40	0.004	6.74
593	PL	U	15-30	156.0	1.430	0.015	627.0	1.93	0.005	1.82	1.04	0.046	2.35	0.002	4.91
593	PL	M	15-30	118.0	0.820	0.147	427.0	4.65	0.002	3.51	0.90	0.057	2.69	0.002	5.68
593	PL	L	15-30	204.0	1.410	0.114	545.0	5.03	0.004	1.51	0.61	0.091	2.70	0.004	5.55
594	PL	U	15-30	151.0	1.490	0.029	304.0	10.30	0.002	1.22	0.72	0.060	6.25	0.002	3.40
594	PL	M	15-30	221.0	1.190	0.035	300.0	3.58	0.002	1.03	0.76	0.080	4.85	0.002	3.87
594	PL	L	15-30	204.0	1.150	0.061	341.0	5.26	0.002	1.05	0.61	0.080	3.78	0.002	3.92
595	PL	U	15-30	167.0	1.600	0.184	760.0	2.31	0.004	3.89	0.81	0.070	4.98	0.004	7.72
595	PL	M	15-30	223.0	1.740	0.049	527.0	4.39	0.003	1.69	0.71	0.056	8.04	0.002	4.85
595	PL	L	15-30	268.0	1.390	0.139	623.0	5.12	0.004	1.04	0.85	0.098	6.02	0.004	4.93
599	PL	U	15-30	173.0	1.290	0.112	616.0	4.96	0.004	4.53	0.79	0.081	4.77	0.004	8.56
599	PL	M	15-30	152.0	1.320	0.120	677.0	4.58	0.004	3.70	0.72	0.056	4.76	0.004	8.61
599	PL	L	15-30	138.0	1.070	0.126	687.0	3.84	0.004	4.39	1.20	0.091	5.38	0.004	8.57
			Mean	128.20	1.09	0.11	428.11	7.07	0.004	2.03	0.88	0.06	6.69	0.0027	5.77
			Max	268.00	1.74	0.26	760.00	72.40	0.016	7.33	2.15	0.10	23.40	0.0040	10.00
			Min	24.00	0.33	0.01	71.90	1.92	0.002	0.37	0.45	0.03	2.23	0.0020	2.19
			SD	72.81	0.39	0.08	182.54	13.29	0.003	1.57	0.45	0.02	5.61	0.0010	1.95
			CV (%)	56.79	35.28	70.24	42.64	188.02	80.06	77.26	50.82	32.03	83.90	36.03	33.82

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
615	MB	U	15-30	109.0	0.928	0.004	194.0	11.40	0.015	0.39	1.52	0.060	6.95	0.002	4.10
615	MB	M	15-30	156.0	0.791	0.044	161.0	19.90	0.002	0.90	1.34	0.069	5.05	0.002	3.84
615	MB	L	15-30	221.0	1.500	0.100	255.0	6.15	0.007	1.82	1.18	0.083	7.30	0.002	7.18
			Mean	162.00	1.07	0.05	203.33	12.48	0.0080	1.04	1.35	0.07	6.43	0.0020	5.04
			Max	221.00	1.50	0.10	255.00	19.90	0.0150	1.82	1.52	0.08	7.30	0.0020	7.18
			Min	109.00	0.79	0.004	161.00	6.15	0.0020	0.39	1.18	0.06	5.05	0.0020	3.84
			SD	56.24	0.38	0.05	47.69	6.94	0.0066	0.72	0.17	0.01	1.21	0.00	1.86
			CV (%)	34.72	35.05	97.75	23.45	55.58	81.97	69.78	12.63	16.40	18.82	0.00	36.86
678	BT	U	15-30	108.0	1.18	0.021	352.0	12.30	0.002	0.83	0.54	0.054	3.44	0.002	11.10
678	BT	M	15-30	142.0	1.19	0.032	252.0	15.60	0.002	1.08	1.30	0.075	5.26	0.002	9.77
678	BT	L	15-30	120.0	1.01	0.224	458.0	10.00	0.002	1.62	0.86	0.071	8.74	0.002	13.50
680	BT	U	15-30	44.7	0.61	0.035	354.0	5.24	0.002	0.52	0.39	0.038	3.10	0.002	2.27
680	BT	M	15-30	70.5	0.46	0.013	309.0	8.51	0.002	1.66	0.74	0.039	3.55	0.002	2.65
680	BT	L	15-30	86.3	0.48	0.025	262.0	6.86	0.002	1.21	1.03	0.042	5.99	0.002	2.49
681	BT	U	15-30	61.0	0.43	0.021	89.0	7.44	0.002	0.82	0.65	0.033	6.15	0.002	3.64
681	BT	M	15-30	57.6	0.41	0.010	99.9	6.18	0.002	0.73	0.57	0.045	4.58	0.002	3.21
681	BT	L	15-30	75.5	0.558	0.070	138.0	9.96	0.002	1.20	0.75	0.047	6.07	0.002	4.15
684	BT	U	15-30	41.2	0.641	0.025	252.0	5.47	0.002	0.84	0.35	0.024	3.87	0.002	5.32
684	BT	M	15-30	53.5	0.650	0.019	188.0	7.60	0.002	1.03	0.40	0.028	3.06	0.002	5.02
684	BT	L	15-30	139.0	0.824	0.008	69.3	22.20	0.002	1.47	1.78	0.075	4.53	0.002	3.66
687	BT	U	15-30	29.0	0.344	0.010	71.6	7.35	0.002	0.58	0.66	0.045	3.43	0.002	2.80
687	BT	M	15-30	29.7	0.383	0.004	69.2	6.38	0.002	0.36	0.56	0.030	3.98	0.002	3.10
687	BT	L	15-30	60.9	0.675	0.119	227.0	10.20	0.002	1.28	0.52	0.057	10.20	0.002	7.64
688	BT	U	15-30	50.9	0.209	0.018	417.0	20.90	0.002	1.99	0.62	0.027	2.96	0.002	8.79
688	BT	M	15-30	86.2	0.308	0.031	372.0	15.70	0.004	4.14	0.79	0.038	4.54	0.002	9.04
688	BT	L	15-30	195.0	0.403	0.025	191.0	29.90	0.005	2.78	0.95	0.072	7.38	0.002	7.43
692	BT	U	15-30	150.0	2.170	0.062	590.0	10.10	0.012	1.98	0.84	0.040	6.89	0.010	10.30
692	BT	M	15-30	254.0	1.860	0.143	736.0	16.90	0.005	1.07	0.80	0.074	7.82	0.004	10.60
692	BT	L	15-30	329.0	0.270	0.114	470.0	10.90	0.013	1.55	1.20	0.043	21.20	0.004	9.07
703	BT	U	15-30	42.3	0.441	0.008	146.0	11.80	0.004	0.63	0.58	0.023	2.62	0.004	4.41
703	BT	M	15-30	47.3	0.581	0.004	115.0	10.00	0.004	0.46	0.50	0.020	1.79	0.004	3.34
703	BT	L	15-30	146.0	1.460	0.093	292.0	8.35	0.007	3.02	0.67	0.081	8.05	0.002	5.70
			Mean	100.82	0.73	0.05	271.67	11.49	0.0036	1.37	0.75	0.05	5.80	0.0027	6.21
			Max	329.00	2.17	0.22	736.00	29.90	0.0130	4.14	1.78	0.08	21.20	0.0100	13.50
			Min	29.00	0.21	0.004	69.20	5.24	0.0020	0.36	0.35	0.02	1.79	0.0020	2.27
			SD	74.43	0.51	0.05	174.04	6.03	0.0031	0.90	0.32	0.02	3.93	0.0017	3.33
			CV (%)	73.82	69.34	115.73	64.06	52.46	85.49	65.88	43.12	40.44	67.79	65.11	53.71

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
727	AP	U	15-30	127.0	7.110	0.115	494.0	35.40	0.018	3.24	3.09	0.040	16.90	0.010	9.04
727	AP	M	15-30	185.0	1.420	0.165	442.0	32.60	0.008	3.43	2.89	0.074	14.90	0.004	7.86
727	AP	L	15-30	344.0	1.720	0.093	258.0	52.00	0.012	5.08	2.72	0.140	14.30	0.004	5.66
728	AP	U	15-30	53.5	0.332	0.033	333.0	5.75	0.017	0.54	0.34	0.056	3.91	0.010	3.50
728	AP	M	15-30	53.1	0.464	0.068	199.0	15.60	0.004	1.31	0.63	0.084	11.50	0.004	4.94
728	AP	L	15-30	125.0	3.200	0.028	179.0	18.50	0.010	1.54	3.35	0.072	15.40	0.010	5.64
730	AP	U	15-30	16.3	0.347	0.020	268.0	5.74	0.004	1.26	0.28	0.056	7.90	0.004	2.61
730	AP	M	15-30	44.2	0.467	0.010	355.0	5.08	0.014	0.68	0.46	0.110	3.80	0.010	3.35
730	AP	L	15-30	48.7	0.484	0.076	355.0	11.30	0.002	1.43	0.37	0.053	7.22	0.002	2.67
738	AP	U	15-30	39.8	0.452	0.045	297.0	35.80	0.004	1.96	0.33	0.064	4.25	0.004	6.44
738	AP	M	15-30	60.4	0.716	0.006	170.0	13.10	0.013	1.20	0.25	0.037	3.00	0.004	4.11
738	AP	L	15-30	79.2	0.452	0.014	171.0	26.60	0.010	1.69	0.30	0.040	3.58	0.010	3.99
739	AP	U	15-30	13.9	0.294	0.041	250.0	6.77	0.004	2.23	0.27	0.054	13.10	0.004	5.20
739	AP	M	15-30	18.2	0.287	0.038	166.0	7.32	0.002	1.21	0.34	0.034	6.96	0.002	3.86
739	AP	L	15-30	19.8	0.270	0.018	162.0	10.80	0.004	1.00	0.24	0.020	4.49	0.004	4.31
740	AP	U	15-30	31.0	0.565	0.031	404.0	13.00	0.007	2.11	0.26	0.036	3.99	0.004	6.68
740	AP	M	15-30	50.6	0.576	0.013	216.0	23.50	0.004	1.85	0.41	0.037	5.08	0.004	4.96
740	AP	L	15-30	51.5	1.180	0.521	609.0	9.36	0.030	1.91	1.36	0.061	28.00	0.004	10.60
743	AP	U	15-30	8.2	0.378	0.086	611.0	7.07	0.004	1.04	0.18	0.020	11.50	0.004	7.48
743	AP	M	15-30	38.3	0.438	0.056	566.0	21.00	0.004	2.74	0.30	0.054	7.94	0.004	7.17
743	AP	L	15-30	59.4	0.545	0.011	340.0	28.70	0.005	1.79	0.31	0.031	3.38	0.004	5.04
744	AP	U	15-30	76.0	0.718	0.020	229.0	13.40	0.004	1.86	0.84	0.020	5.64	0.004	5.13
744	AP	M	15-30	101.0	0.894	0.021	142.0	15.90	0.002	2.79	0.88	0.028	7.66	0.002	5.14
744	AP	L	15-30	222.0	0.838	0.031	162.0	18.90	0.007	4.22	1.10	0.110	8.59	0.004	4.66
746	AP	U	15-30	39.0	0.514	0.037	177.0	16.70	0.004	1.64	1.10	0.050	12.60	0.004	3.05
746	AP	M	15-30	68.9	0.648	0.013	183.0	14.60	0.004	1.54	0.60	0.059	8.56	0.004	3.31
746	AP	L	15-30	130.0	1.130	0.015	166.0	26.50	0.004	2.12	0.79	0.077	9.65	0.004	3.01
			Mean	77.93	0.98	0.06	292.74	18.18	0.0076	1.98	0.89	0.06	9.03	0.0049	5.16
			Max	344.00	7.11	0.52	611.00	52.00	0.0300	5.08	3.35	0.14	28.00	0.0100	10.60
			Min	8.21	0.27	0.01	142.00	5.08	0.0020	0.54	0.18	0.02	3.00	0.0020	2.61
			SD	74.09	1.37	0.10	144.44	11.40	0.0064	1.05	0.96	0.03	5.64	0.0026	1.98
			CV (%)	95.08	139.61	165.05	49.34	62.71	83.96	52.83	107.77	52.08	62.43	52.41	38.41

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
769	MM	U	15-30	60.7	0.493	0.119	327.0	19.50	0.005	1.16	0.81	0.050	6.40	0.002	5.36
769	MM	M	15-30	121.0	0.490	0.049	115.0	30.70	0.005	1.58	1.19	0.076	11.00	0.002	3.61
769	MM	L	15-30	127.0	0.722	0.047	128.0	21.20	0.010	1.17	1.50	0.098	8.74	0.010	3.60
781	MM	U	15-30	91.4	1.140	0.049	305.0	32.10	0.012	1.44	0.90	0.072	9.21	0.008	5.41
781	MM	M	15-30	99.9	1.060	0.054	305.0	32.90	0.010	2.15	0.79	0.130	9.14	0.010	5.46
781	MM	L	15-30	130.0	1.400	0.047	349.0	43.20	0.011	2.05	1.10	0.130	10.10	0.004	4.45
786	MM	U	15-30	21.5	0.371	0.028	191.0	5.17	0.002	1.88	0.60	0.030	10.40	0.002	4.16
786	MM	M	15-30	24.3	0.324	0.023	144.0	6.15	0.002	1.20	0.62	0.038	10.10	0.002	4.39
786	MM	L	15-30	130.0	0.725	0.010	58.1	5.37	0.010	0.57	0.88	0.210	2.94	0.010	2.07
791	MM	U	15-30	31.8	0.555	0.079	172.0	14.70	0.002	2.00	0.50	0.037	9.22	0.002	3.91
791	MM	M	15-30	26.6	0.559	0.049	186.0	6.99	0.002	1.54	0.26	0.040	10.90	0.002	5.55
791	MM	L	15-30	220.0	1.220	0.030	109.0	36.80	0.003	2.97	0.52	0.127	4.87	0.002	2.82
793	MM	U	15-30	19.7	0.473	0.044	154.0	10.30	0.002	0.89	0.38	0.069	13.40	0.002	3.09
793	MM	M	15-30	16.7	0.393	0.037	144.0	6.07	0.002	0.88	0.31	0.062	8.54	0.002	2.69
793	MM	L	15-30	31.7	0.451	0.032	147.0	13.60	0.002	1.18	0.54	0.056	7.06	0.002	2.21
			Mean	76.82	0.69	0.05	188.94	18.98	0.0053	1.51	0.73	0.08	8.80	0.0041	3.92
			Max	220.00	1.40	0.12	349.00	43.20	0.0120	2.97	1.50	0.21	13.40	0.0100	5.55
			Min	16.70	0.32	0.01	58.10	5.17	0.0020	0.57	0.26	0.03	2.94	0.0020	2.07
			SD	60.30	0.35	0.03	89.29	13.06	0.0040	0.62	0.35	0.05	2.61	0.0034	1.19
			CV (%)	78.50	49.91	55.15	47.26	68.77	75.22	40.81	47.74	60.44	29.67	82.74	30.38
798	FG	U	15-30	57.1	0.618	0.020	131.0	16.70	0.002	1.39	0.60	0.071	7.61	0.002	2.97
798	FG	M	15-30	41.9	0.555	0.024	138.0	15.10	0.002	1.33	0.56	0.082	8.47	0.002	3.17
798	FG	L	15-30	83.1	0.888	0.010	161.0	17.00	0.012	1.05	0.80	0.170	3.74	0.010	3.24
800	FG	U	15-30	93.6	1.270	0.083	243.0	45.30	0.012	3.72	0.69	0.088	8.01	0.010	3.91
800	FG	M	15-30	102.0	1.360	0.107	379.0	47.50	0.019	4.05	0.74	0.230	7.93	0.010	4.86
800	FG	L	15-30	97.7	1.300	0.103	315.0	38.50	0.010	3.88	0.81	0.110	8.71	0.010	5.12
			Mean	79.23	1.00	0.06	227.83	30.02	0.0095	2.57	0.70	0.13	7.41	0.0073	3.88
			Max	102.00	1.36	0.11	379.00	47.50	0.0190	4.05	0.81	0.23	8.71	0.0100	5.12
			Min	41.90	0.56	0.01	131.00	15.10	0.0020	1.05	0.56	0.07	3.74	0.0020	2.97
			SD	24.35	0.36	0.04	102.56	15.37	0.0066	1.45	0.10	0.06	1.84	0.0041	0.92
			CV (%)	30.73	36.08	77.15	45.02	51.19	69.11	56.30	14.76	49.78	24.84	56.33	23.75

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Iron ² (mg/kg) (0.006) ⁵	Lead ² (mg/kg) (0.004) ⁵	Lithium ² (mg/kg) (0.002) ⁵	Magnesium ² (mg/kg) (0.1) ⁵	Manganese ² (mg/kg) (0.0004) ⁵	Molybdenum ² (mg/kg) (0.002) ⁵	Nickel ² (mg/kg) (0.002) ⁵	Phosphorus ² (mg/kg) (0.06) ⁵	Selenium ² (mg/kg) (0.008) ⁵	Silicon ² (mg/kg) (0.008) ⁵	Silver ² (mg/kg) (0.002) ⁵	Strontium ² (mg/kg) (0.0002) ⁵
804	MG	U	15-30	37.8	0.347	0.106	174.0	9.20	0.002	1.55	0.52	0.080	7.67	0.002	4.32
804	MG	M	15-30	25.3	0.302	0.143	211.0	9.02	0.003	1.15	0.49	0.072	11.80	0.002	5.00
804	MG	L	15-30	66.7	0.446	0.176	284.0	11.50	0.004	1.72	0.71	0.079	6.42	0.002	4.71
806	MG	U	15-30	31.6	0.398	0.142	358.0	6.66	0.004	1.30	0.28	0.071	9.02	0.002	5.38
806	MG	M	15-30	52.5	0.360	0.131	255.0	12.00	0.002	1.41	0.46	0.085	5.51	0.002	4.17
806	MG	L	15-30	76.6	0.541	0.089	223.0	15.10	0.002	1.46	0.59	0.047	4.34	0.002	4.74
809	MG	U	15-30	13.7	0.413	0.047	288.0	9.92	0.002	0.97	0.30	0.034	17.20	0.002	2.98
809	MG	M	15-30	22.3	0.466	0.066	352.0	12.60	0.002	1.82	0.37	0.035	9.88	0.002	3.45
809	MG	L	15-30	36.8	0.297	0.055	217.0	12.30	0.002	1.24	0.48	0.039	10.60	0.002	3.48
812	MG	U	15-30	18.5	0.779	0.214	384.0	10.20	0.003	1.28	0.14	0.036	14.90	0.002	10.10
812	MG	M	15-30	21.0	0.674	0.248	479.0	10.40	0.005	1.27	0.20	0.036	13.90	0.002	8.86
812	MG	L	15-30	30.7	0.880	0.255	665.0	12.50	0.008	1.51	0.32	0.045	17.90	0.002	8.56
815	MG	U	15-30	8.5	0.368	0.045	178.0	4.50	0.002	0.68	0.17	0.031	13.30	0.002	3.94
815	MG	M	15-30	12.1	0.332	0.041	136.0	6.29	0.002	1.51	0.31	0.042	15.90	0.002	3.20
815	MG	L	15-30	162.0	0.872	0.056	219.0	20.50	0.009	1.55	0.64	0.086	9.91	0.002	3.50
823	MG	U	15-30	9.1	3.200	0.074	217.0	11.90	0.011	1.20	0.90	0.063	16.70	0.002	3.62
823	MG	M	15-30	19.9	0.443	0.069	244.0	23.10	0.003	1.14	0.28	0.068	19.40	0.002	3.69
823	MG	L	15-30	23.4	0.432	0.055	225.0	26.80	0.002	1.19	0.36	0.063	18.50	0.002	3.40
1828	MG	U	15-30	6.6	0.296	0.036	157.0	5.11	0.002	0.64	0.17	0.053	13.40	0.002	3.51
1828	MG	M	15-30	23.1	0.529	0.089	453.0	13.20	0.004	1.48	0.22	0.052	12.00	0.004	4.85
1828	MG	L	15-30	19.9	0.502	0.074	258.0	19.40	0.002	1.40	0.30	0.062	15.10	0.002	3.64
2828	MG	U	15-30	25.6	0.551	0.089	250.0	10.80	0.002	2.12	0.40	0.045	9.34	0.002	3.62
2828	MG	M	15-30	40.7	0.488	0.071	231.0	23.50	0.002	2.22	0.37	0.068	9.10	0.002	3.36
2828	MG	L	15-30	31.2	0.613	0.074	229.0	20.80	0.007	2.36	0.34	0.060	9.68	0.002	3.29
			Mean	33.98	0.61	0.10	278.63	13.22	0.0036	1.42	0.39	0.06	12.14	0.0021	4.56
			Max	162.00	3.20	0.26	665.00	26.80	0.0110	2.36	0.90	0.09	19.40	0.0040	10.10
			Min	6.55	0.30	0.04	136.00	4.50	0.0020	0.64	0.14	0.03	4.34	0.0020	2.98
			SD	32.26	0.58	0.06	119.49	6.07	0.0026	0.42	0.18	0.02	4.23	0.0004	1.91
			CV (%)	94.94	95.41	62.74	42.88	45.94	70.83	29.39	47.58	30.85	34.86	19.60	41.82

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
586	PL	U	15-30	22.90	0.016	0.042	0.0017	0.004	0.73	0.07	0.10	1.370	0.02	0.022	0.185	0.009
586	PL	M	15-30	24.50	0.008	0.033	0.0011	0.002	0.93	0.02	0.04	1.590	0.02	0.008	0.139	0.008
586	PL	L	15-30	25.50	0.008	0.042	0.0014	0.002	4.39	0.04	0.08	1.310	0.08	0.006	0.146	0.022
588	PL	U	15-30	17.50	0.008	0.041	0.0015	0.002	0.57	0.02	0.05	1.110	0.02	0.015	0.172	0.031
588	PL	M	15-30	24.90	0.008	0.043	0.0024	0.002	4.30	0.03	0.04	1.250	0.02	0.021	0.100	0.008
588	PL	L	15-30	15.90	0.008	0.055	0.0032	0.005	3.11	0.02	0.04	1.000	0.04	0.015	0.061	0.008
590	PL	U	15-30	12.20	0.008	0.042	0.0008	0.002	0.32	0.02	0.05	0.718	0.02	0.008	0.066	0.008
590	PL	M	15-30	11.60	0.008	0.046	0.0008	0.002	0.71	0.02	0.04	0.719	0.02	0.004	0.072	0.014
590	PL	L	15-30	10.40	0.008	0.041	0.0026	0.002	0.75	0.02	0.04	0.783	0.02	0.012	0.100	0.010
591	PL	U	15-30	10.00	0.008	0.033	0.0011	0.002	0.23	0.02	0.04	0.704	0.02	0.008	0.094	0.008
591	PL	M	15-30	11.20	0.008	0.032	0.0008	0.002	0.88	0.02	0.05	0.708	0.02	0.010	0.084	0.019
591	PL	L	15-30	24.70	0.016	0.010	0.0028	0.004	16.60	0.02	0.06	2.160	0.02	0.038	0.106	0.008
592	PL	U	15-30	17.60	0.008	0.022	0.0008	0.002	1.34	0.02	0.05	0.119	0.03	0.003	0.156	0.008
592	PL	M	15-30	18.60	0.008	0.035	0.0008	0.002	1.67	0.02	0.04	0.181	0.05	0.005	0.167	0.008
592	PL	L	15-30	26.70	0.016	0.039	0.0022	0.010	15.40	0.02	0.04	0.497	0.05	0.009	0.082	0.008
593	PL	U	15-30	16.20	0.008	0.028	0.0063	0.002	1.00	0.08	0.19	2.880	0.02	0.068	0.454	0.008
593	PL	M	15-30	12.80	0.008	0.036	0.0028	0.002	2.36	0.04	0.08	1.720	0.03	0.007	0.193	0.016
593	PL	L	15-30	20.00	0.016	0.053	0.0029	0.004	1.37	0.05	0.17	1.750	0.04	0.027	0.256	0.016
594	PL	U	15-30	24.20	0.008	0.057	0.0104	0.002	0.79	0.04	0.08	0.631	0.03	0.008	0.031	0.058
594	PL	M	15-30	21.10	0.008	0.045	0.0037	0.002	0.60	0.04	0.08	0.552	0.06	0.008	0.034	0.040
594	PL	L	15-30	24.90	0.008	0.049	0.0017	0.002	0.99	0.04	0.08	0.498	0.04	0.008	0.052	0.037
595	PL	U	15-30	31.60	0.016	0.053	0.0046	0.004	1.38	0.10	0.20	2.070	0.08	0.010	0.252	0.150
595	PL	M	15-30	35.10	0.008	0.031	0.0096	0.002	3.03	0.08	0.10	1.610	0.04	0.022	0.149	0.020
595	PL	L	15-30	40.60	0.016	0.026	0.0038	0.004	1.28	0.04	0.08	1.010	0.07	0.007	0.125	0.110
599	PL	U	15-30	14.80	0.016	0.033	0.0038	0.004	2.02	0.09	0.13	2.380	0.02	0.045	0.293	0.008
599	PL	M	15-30	15.10	0.016	0.032	0.0025	0.004	2.04	0.15	0.08	2.270	0.06	0.048	0.338	0.020
599	PL	L	15-30	15.90	0.016	0.055	0.0036	0.004	2.23	0.15	0.11	2.430	0.03	0.025	0.247	0.016
			Mean	20.24	0.0107	0.04	0.0030	0.0030	2.63	0.05	0.08	1.26	0.04	0.02	0.15	0.03
			Max	40.60	0.0160	0.06	0.0104	0.0100	16.60	0.15	0.20	2.88	0.08	0.07	0.45	0.15
			Min	10.00	0.0080	0.01	0.0008	0.0020	0.23	0.02	0.04	0.12	0.02	0.00	0.03	0.01
			SD	7.71	0.0038	0.01	0.0024	0.0017	4.01	0.04	0.05	0.75	0.02	0.02	0.10	0.03
			CV (%)	38.07	36.03	28.33	82.71	57.74	152.43	80.56	58.34	59.35	54.18	91.59	65.10	132.15

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
615	MB	U	15-30	25.70	0.008	0.058	0.0127	0.007	14.50	0.05	0.08	1.460	0.05	0.021	0.145	0.024
615	MB	M	15-30	19.60	0.008	0.059	0.0045	0.002	7.07	0.05	0.04	0.856	0.02	0.036	0.085	0.008
615	MB	L	15-30	43.60	0.008	0.065	0.0071	0.009	4.99	0.04	0.08	1.760	0.13	0.010	0.099	0.016
			Mean	29.63	0.0080	0.06	0.0081	0.0060	8.85	0.05	0.07	1.36	0.07	0.02	0.11	0.02
			Max	43.60	0.0080	0.07	0.0127	0.0090	14.50	0.05	0.08	1.76	0.13	0.04	0.15	0.02
			Min	19.60	0.0080	0.06	0.0045	0.0020	4.99	0.04	0.04	0.86	0.02	0.01	0.09	0.01
			SD	12.47	0.00	0.004	0.0042	0.0036	5.00	0.01	0.02	0.46	0.06	0.01	0.03	0.01
			CV (%)	42.09	0.00	6.24	51.73	60.09	56.47	12.37	34.64	33.89	85.29	58.44	28.62	50.00
678	BT	U	15-30	20.80	0.008	0.057	0.0060	0.002	1.170	0.02	0.04	0.958	0.02	0.014	0.039	0.008
678	BT	M	15-30	31.00	0.008	0.062	0.0084	0.002	4.830	0.02	0.04	0.794	0.05	0.014	0.034	0.008
678	BT	L	15-30	23.20	0.008	0.038	0.0021	0.002	5.910	0.02	0.04	1.460	0.02	0.008	0.045	0.008
680	BT	U	15-30	12.00	0.008	0.060	0.0042	0.002	0.286	0.05	0.04	0.679	0.02	0.028	0.088	0.008
680	BT	M	15-30	12.10	0.008	0.087	0.0042	0.002	1.300	0.02	0.04	0.787	0.02	0.016	0.046	0.008
680	BT	L	15-30	13.00	0.008	0.070	0.0038	0.004	2.440	0.02	0.04	0.927	0.02	0.018	0.035	0.008
681	BT	U	15-30	10.80	0.008	0.075	0.0027	0.002	1.010	0.02	0.04	0.514	0.02	0.008	0.034	0.008
681	BT	M	15-30	11.40	0.008	0.074	0.0024	0.002	0.463	0.02	0.04	0.417	0.02	0.010	0.043	0.008
681	BT	L	15-30	11.80	0.008	0.075	0.0015	0.002	1.25	0.02	0.04	0.643	0.06	0.009	0.032	0.012
684	BT	U	15-30	16.30	0.008	0.066	0.0011	0.002	0.24	0.07	0.25	0.696	0.02	0.076	0.304	0.027
684	BT	M	15-30	14.40	0.008	0.062	0.0020	0.002	0.54	0.03	0.04	0.421	0.02	0.025	0.050	0.015
684	BT	L	15-30	17.00	0.008	0.054	0.0085	0.005	5.67	0.02	0.08	0.691	0.02	0.013	0.054	0.008
687	BT	U	15-30	11.90	0.008	0.080	0.0034	0.003	0.22	0.02	0.06	0.315	0.02	0.007	0.041	0.008
687	BT	M	15-30	13.30	0.008	0.075	0.0037	0.002	0.29	0.02	0.05	0.382	0.02	0.008	0.054	0.008
687	BT	L	15-30	28.10	0.008	0.086	0.0013	0.006	1.85	0.02	0.05	0.874	0.02	0.009	0.043	0.008
688	BT	U	15-30	15.30	0.008	0.066	0.0034	0.002	0.92	0.02	0.07	0.954	0.02	0.005	0.056	0.008
688	BT	M	15-30	18.50	0.008	0.061	0.0045	0.002	1.40	0.02	0.05	0.915	0.02	0.007	0.052	0.013
688	BT	L	15-30	14.40	0.008	0.060	0.0058	0.002	10.80	0.02	0.04	1.130	0.02	0.010	0.046	0.008
692	BT	U	15-30	19.60	0.095	0.060	0.0094	0.010	2.56	0.04	0.13	1.470	0.03	0.007	0.106	0.020
692	BT	M	15-30	26.20	0.016	0.033	0.0064	0.004	1.92	0.04	0.09	1.080	0.06	0.006	0.088	0.020
692	BT	L	15-30	25.00	0.016	0.047	0.0058	0.004	0.52	0.04	0.08	0.803	0.03	0.010	0.034	0.020
703	BT	U	15-30	13.90	0.016	0.076	0.0042	0.004	0.00	0.02	0.07	0.320	0.02	0.011	0.059	0.008
703	BT	M	15-30	12.60	0.016	0.100	0.0064	0.004	0.00	0.02	0.04	0.271	0.02	0.008	0.059	0.011
703	BT	L	15-30	27.90	0.008	0.058	0.0040	0.046	2.53	0.02	0.04	0.524	0.02	0.003	0.070	0.008
			Mean	17.52	0.0130	0.07	0.0044	0.0049	2.01	0.03	0.06	0.75	0.03	0.01	0.06	0.01
			Max	31.00	0.0950	0.10	0.0094	0.0460	10.80	0.07	0.25	1.47	0.06	0.08	0.30	0.03
			Min	10.80	0.0080	0.03	0.0011	0.0020	0.00	0.02	0.04	0.27	0.02	0.003	0.03	0.01
			SD	6.22	0.0177	0.02	0.0023	0.0089	2.52	0.01	0.05	0.33	0.01	0.01	0.05	0.01
			CV (%)	35.49	136.87	23.04	52.60	182.01	125.63	48.72	73.28	44.15	49.19	105.55	86.81	48.47

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
727	AP	U	15-30	41.40	0.110	0.059	0.0072	0.010	12.10	0.04	0.08	1.330	0.03	0.006	0.067	0.020
727	AP	M	15-30	36.50	0.016	0.088	0.0170	0.008	6.07	0.02	0.04	1.420	0.02	0.004	0.056	0.008
727	AP	L	15-30	48.40	0.016	0.046	0.0215	0.006	10.20	0.04	0.08	1.310	0.03	0.013	0.069	0.020
728	AP	U	15-30	15.80	0.040	0.100	0.0057	0.010	0.70	0.02	0.04	0.922	0.04	0.007	0.071	0.012
728	AP	M	15-30	20.00	0.016	0.060	0.0028	0.004	2.74	0.02	0.06	1.900	0.02	0.004	0.067	0.015
728	AP	L	15-30	27.80	0.040	0.067	0.0350	0.016	23.30	0.04	0.08	3.220	0.03	0.007	0.107	0.020
730	AP	U	15-30	17.50	0.016	0.088	0.0020	0.007	0.23	0.02	0.04	0.322	0.02	0.003	0.130	0.008
730	AP	M	15-30	16.90	0.040	0.063	0.0057	0.010	0.46	0.02	0.04	0.566	0.02	0.004	0.072	0.008
730	AP	L	15-30	12.10	0.008	0.072	0.0008	0.002	0.56	0.02	0.11	0.778	0.03	0.015	0.071	0.020
738	AP	U	15-30	20.10	0.016	0.045	0.0017	0.004	1.34	0.02	0.06	0.845	0.02	0.008	0.080	0.008
738	AP	M	15-30	21.10	0.016	0.097	0.0082	0.004	1.88	0.02	0.06	0.475	0.03	0.008	0.046	0.014
738	AP	L	15-30	21.00	0.040	0.065	0.0100	0.010	3.68	0.02	0.05	0.657	0.02	0.007	0.056	0.008
739	AP	U	15-30	13.40	0.016	0.065	0.0020	0.004	0.47	0.02	0.05	0.401	0.02	0.005	0.071	0.008
739	AP	M	15-30	10.80	0.008	0.068	0.0012	0.003	0.32	0.02	0.05	0.517	0.03	0.003	0.037	0.008
739	AP	L	15-30	12.30	0.016	0.079	0.0020	0.004	0.38	0.02	0.13	0.427	0.03	0.014	0.054	0.027
740	AP	U	15-30	20.00	0.016	0.085	0.0034	0.004	0.39	0.02	0.07	0.599	0.02	0.009	0.083	0.008
740	AP	M	15-30	20.70	0.016	0.051	0.0030	0.004	3.06	0.02	0.04	1.420	0.02	0.005	0.054	0.008
740	AP	L	15-30	1150.00	0.016	0.078	0.0051	0.098	6.63	0.02	0.13	1.630	0.02	0.011	0.122	0.008
743	AP	U	15-30	14.20	0.016	0.044	0.0020	0.004	0.26	0.02	0.04	0.483	0.02	0.005	0.094	0.008
743	AP	M	15-30	18.50	0.016	0.072	0.0018	0.004	0.85	0.02	0.04	0.344	0.02	0.005	0.120	0.008
743	AP	L	15-30	15.80	0.016	0.073	0.0088	0.004	2.15	0.02	0.06	0.541	0.03	0.007	0.044	0.008
744	AP	U	15-30	17.00	0.016	0.050	0.0019	0.004	0.86	0.02	0.05	0.765	0.04	0.006	0.047	0.008
744	AP	M	15-30	16.60	0.008	0.045	0.0038	0.002	1.94	0.02	0.06	0.933	0.02	0.005	0.048	0.008
744	AP	L	15-30	21.80	0.016	0.029	0.0061	0.004	6.91	0.02	0.07	1.110	0.02	0.008	0.064	0.008
746	AP	U	15-30	15.70	0.016	0.073	0.0023	0.004	1.19	0.02	0.06	0.550	0.02	0.005	0.079	0.008
746	AP	M	15-30	14.50	0.016	0.055	0.0052	0.004	1.56	0.02	0.07	1.010	0.02	0.003	0.060	0.008
746	AP	L	15-30	17.30	0.016	0.041	0.0160	0.004	2.45	0.02	0.06	1.090	0.02	0.007	0.039	0.008
			Mean	62.12	0.0221	0.07	0.0067	0.0090	3.43	0.02	0.06	0.95	0.02	0.01	0.07	0.01
			Max	1150.00	0.1100	0.10	0.0350	0.0980	23.30	0.04	0.13	3.22	0.04	0.02	0.13	0.03
			Min	10.80	0.0080	0.03	0.0008	0.0020	0.23	0.02	0.04	0.32	0.02	0.003	0.04	0.01
			SD	217.59	0.0199	0.02	0.0077	0.0181	5.04	0.01	0.03	0.62	0.01	0.003	0.03	0.01
			CV (%)	350.29	89.92	27.56	113.69	201.69	146.94	28.82	39.70	65.53	26.20	47.47	35.61	49.19

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
769	MM	U	15-30	25.00	0.008	0.056	0.0047	0.002	1.11	0.02	0.06	0.776	0.04	0.012	0.044	0.008
769	MM	M	15-30	23.80	0.008	0.055	0.0307	0.009	4.88	0.02	0.13	0.791	0.03	0.023	0.062	0.018
769	MM	L	15-30	29.70	0.040	0.100	0.0501	0.010	2.33	0.02	0.06	0.715	0.02	0.019	0.061	0.008
781	MM	U	15-30	25.20	0.032	0.100	0.0150	0.008	1.89	0.04	0.12	1.010	0.03	0.022	0.067	0.020
781	MM	M	15-30	26.20	0.040	0.099	0.0110	0.010	1.95	0.04	0.12	0.947	0.04	0.014	0.063	0.020
781	MM	L	15-30	26.90	0.016	0.076	0.0247	0.008	2.36	0.04	0.08	1.010	0.04	0.020	0.088	0.020
786	MM	U	15-30	10.90	0.008	0.079	0.0008	0.003	0.78	0.02	0.06	0.396	0.02	0.012	0.119	0.010
786	MM	M	15-30	8.73	0.008	0.082	0.0015	0.006	0.58	0.02	0.15	0.568	0.02	0.018	0.080	0.028
786	MM	L	15-30	14.70	0.040	0.110	0.0370	0.010	1.01	0.02	0.06	0.361	0.02	0.016	0.048	0.008
791	MM	U	15-30	8.35	0.008	0.056	0.0008	0.002	0.33	0.02	0.08	0.559	0.02	0.006	0.084	0.010
791	MM	M	15-30	8.22	0.008	0.057	0.0008	0.009	0.36	0.02	0.04	0.563	0.02	0.007	0.142	0.008
791	MM	L	15-30	10.60	0.008	0.038	0.0037	0.002	4.54	0.02	0.19	0.618	0.02	0.037	0.123	0.036
793	MM	U	15-30	9.62	0.008	0.056	0.0008	0.016	0.76	0.04	0.08	0.530	0.03	0.006	0.108	0.016
793	MM	M	15-30	8.12	0.008	0.064	0.0008	0.013	0.29	0.02	0.04	0.440	0.02	0.009	0.090	0.008
793	MM	L	15-30	9.34	0.008	0.054	0.0008	0.004	0.54	0.02	0.17	0.699	0.03	0.019	0.087	0.040
			Mean	16.36	0.0165	0.07	0.0122	0.0075	1.58	0.03	0.10	0.67	0.03	0.02	0.08	0.02
			Max	29.70	0.0400	0.11	0.0501	0.0160	4.88	0.04	0.19	1.01	0.04	0.04	0.14	0.04
			Min	8.12	0.0080	0.04	0.0008	0.0020	0.29	0.02	0.04	0.36	0.02	0.01	0.04	0.01
			SD	8.50	0.0137	0.02	0.0160	0.0042	1.46	0.01	0.05	0.21	0.01	0.01	0.03	0.01
			CV (%)	51.95	82.74	30.40	130.97	56.79	92.16	36.14	49.61	31.53	30.62	50.94	33.81	61.02
798	FG	U	15-30	12.30	0.008	0.071	0.0054	0.004	1.09	0.02	0.06	1.450	0.02	0.006	0.081	0.011
798	FG	M	15-30	10.50	0.008	0.053	0.0027	0.006	1.03	0.02	0.11	1.610	0.05	0.007	0.063	0.023
798	FG	L	15-30	13.80	0.040	0.030	0.0040	0.010	1.75	0.02	0.12	0.933	0.04	0.017	0.088	0.019
800	FG	U	15-30	10.00	0.040	0.039	0.0040	0.010	1.47	0.02	0.05	1.160	0.03	0.003	0.044	0.016
800	FG	M	15-30	10.70	0.040	0.076	0.0040	0.010	1.59	0.02	0.09	1.090	0.05	0.003	0.036	0.008
800	FG	L	15-30	10.50	0.091	0.030	0.0040	0.010	1.93	0.02	0.07	0.985	0.04	0.003	0.059	0.012
			Mean	11.30	0.0378	0.05	0.0040	0.0083	1.48	0.02	0.08	1.20	0.04	0.01	0.06	0.01
			Max	13.80	0.0910	0.08	0.0054	0.0100	1.93	0.02	0.12	1.61	0.05	0.02	0.09	0.02
			Min	10.00	0.0080	0.03	0.0027	0.0040	1.03	0.02	0.05	0.93	0.02	0.00	0.04	0.01
			SD	1.45	0.0304	0.02	0.0009	0.0027	0.36	0.00	0.03	0.27	0.01	0.01	0.02	0.01
			CV (%)	12.87	80.35	40.60	21.27	31.90	24.27	0.00	33.66	22.33	30.50	83.56	32.72	37.52

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Sulphur ² (mg/kg) (0.02) ⁵	Thallium ² (mg/kg) (0.008) ⁵	Tin ² (mg/kg) (0.006) ⁵	Titanium ² (mg/kg) (0.0008) ⁵	Vanadium ² (mg/kg) (0.002) ⁵	Zinc ² (mg/kg) (0.001) ⁵	Antimony ³ (mg/kg) (0.02) ⁵	Arsenic ³ (mg/kg) (0.04) ⁵	Boron ³ (mg/kg) (0.008) ⁵	Selenium ³ (mg/kg) (0.02) ⁵	Cobalt ³ (mg/kg) (0.003) ⁵	Copper ³ (mg/kg) (0.004) ⁵	Lead ³ (mg/kg) (0.008) ⁵
804	MG	U	15-30	9.03	0.008	0.059	0.0008	0.002	0.55	0.02	0.10	0.778	0.05	0.007	0.088	0.023
804	MG	M	15-30	10.50	0.008	0.075	0.0008	0.003	0.42	0.02	0.09	0.675	0.05	0.010	0.108	0.021
804	MG	L	15-30	14.30	0.008	0.061	0.0026	0.004	1.35	0.02	0.07	0.829	0.07	0.016	0.179	0.008
806	MG	U	15-30	14.80	0.008	0.050	0.0008	0.003	0.44	0.02	0.07	0.773	0.03	0.009	0.151	0.008
806	MG	M	15-30	13.70	0.008	0.063	0.0011	0.002	0.78	0.02	0.19	0.680	0.05	0.029	0.105	0.033
806	MG	L	15-30	18.60	0.008	0.049	0.0053	0.002	1.28	0.02	0.16	0.793	0.02	0.023	0.080	0.039
809	MG	U	15-30	10.20	0.008	0.061	0.0009	0.053	0.50	0.02	0.06	0.756	0.02	0.010	0.156	0.008
809	MG	M	15-30	9.39	0.008	0.054	0.0008	0.013	0.49	0.02	0.05	0.682	0.02	0.003	0.152	0.008
809	MG	L	15-30	10.10	0.008	0.062	0.0050	0.003	0.58	0.02	0.11	0.628	0.05	0.004	0.080	0.037
812	MG	U	15-30	61.40	0.008	0.048	0.0008	0.002	0.39	0.02	0.04	0.713	0.02	0.008	0.177	0.010
812	MG	M	15-30	122.00	0.008	0.049	0.0008	0.003	0.41	0.02	0.04	0.657	0.05	0.006	0.156	0.008
812	MG	L	15-30	70.20	0.008	0.055	0.0008	0.023	0.68	0.02	0.04	0.788	0.03	0.009	0.211	0.008
815	MG	U	15-30	8.61	0.008	0.058	0.0008	0.013	0.22	0.02	0.05	0.628	0.03	0.003	0.126	0.015
815	MG	M	15-30	9.27	0.008	0.064	0.0008	0.030	0.28	0.02	0.04	0.571	0.04	0.003	0.161	0.009
815	MG	L	15-30	13.10	0.008	0.052	0.0030	0.009	1.60	0.02	0.12	0.727	0.07	0.018	0.151	0.020
823	MG	U	15-30	30.80	0.008	0.051	0.0085	0.023	0.51	0.02	0.04	0.559	0.04	0.010	0.184	0.017
823	MG	M	15-30	20.70	0.008	0.059	0.0039	0.019	0.96	0.02	0.15	0.770	0.07	0.038	0.132	0.031
823	MG	L	15-30	28.60	0.008	0.062	0.0037	0.018	1.31	0.02	0.05	0.822	0.05	0.005	0.215	0.023
1828	MG	U	15-30	6.87	0.008	0.063	0.0016	0.016	0.10	0.02	0.05	0.502	0.02	0.003	0.098	0.013
1828	MG	M	15-30	8.41	0.016	0.052	0.0041	0.004	0.27	0.02	0.07	0.811	0.05	0.005	0.124	0.030
1828	MG	L	15-30	8.27	0.008	0.061	0.0040	0.009	0.27	0.02	0.07	0.702	0.04	0.003	0.114	0.013
2828	MG	U	15-30	11.70	0.008	0.048	0.0009	0.005	0.22	0.02	0.04	0.347	0.02	0.003	0.132	0.008
2828	MG	M	15-30	12.60	0.008	0.048	0.0026	0.003	0.39	0.02	0.06	0.495	0.05	0.006	0.107	0.018
2828	MG	L	15-30	13.60	0.008	0.050	0.0030	0.004	0.28	0.02	0.04	0.235	0.03	0.003	0.157	0.010
			Mean	22.36	0.0083	0.06	0.0024	0.0111	0.59	0.02	0.08	0.66	0.04	0.01	0.14	0.02
			Max	122.00	0.0160	0.08	0.0085	0.0530	1.60	0.02	0.19	0.83	0.07	0.04	0.22	0.04
			Min	6.87	0.0080	0.05	0.0008	0.0020	0.10	0.02	0.04	0.24	0.02	0.00	0.08	0.01
			SD	26.55	0.0016	0.01	0.0020	0.0121	0.41	0.00	0.04	0.15	0.02	0.01	0.04	0.01
			CV (%)	118.72	19.60	12.32	83.82	109.60	69.20	0.00	56.84	22.68	40.94	92.94	27.34	58.21

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
586	PL	U	15-30	0.016	0.066	584.0	0.506	1.1
586	PL	M	15-30	0.018	0.151	51.4	0.053	0.7
586	PL	L	15-30	0.020	0.090	68.5	0.062	0.9
588	PL	U	15-30	0.016	0.038	30.3	0.155	0.3
588	PL	M	15-30	0.015	0.110	94.8	0.069	0.3
588	PL	L	15-30	0.004	0.093	70.4	0.132	0.3
590	PL	U	15-30	0.023	0.056	35.5	0.077	0.3
590	PL	M	15-30	0.004	0.054	62.2	0.104	0.3
590	PL	L	15-30	0.004	0.059	162.0	0.172	0.3
591	PL	U	15-30	0.004	0.067	203.0	0.096	0.5
591	PL	M	15-30	0.046	0.059	28.3	0.033	0.3
591	PL	L	15-30	0.004	0.240	196.0	0.193	1.1
592	PL	U	15-30	0.045	0.070	46.8	0.017	0.3
592	PL	M	15-30	0.038	0.089	158.0	0.061	0.3
592	PL	L	15-30	0.100	0.075	104.0	0.061	1.0
593	PL	U	15-30	0.013	0.259	1970.0	1.430	1.5
593	PL	M	15-30	0.008	0.127	903.0	0.573	0.7
593	PL	L	15-30	0.008	0.018	1390.0	0.705	0.6
594	PL	U	15-30	0.008	0.019	80.9	0.011	0.4
594	PL	M	15-30	0.008	0.015	91.5	0.008	0.6
594	PL	L	15-30	0.008	0.045	144.0	0.024	0.3
595	PL	U	15-30	0.020	0.374	81.1	0.078	2.3
595	PL	M	15-30	0.008	0.072	729.0	0.508	0.9
595	PL	L	15-30	0.008	0.025	228.0	0.078	0.7
599	PL	U	15-30	0.011	0.269	1750.0	1.300	1.0
599	PL	M	15-30	0.374	0.262	953.0	1.230	1.3
599	PL	L	15-30	0.008	0.314	934.0	0.783	1.4
Mean				0.03	0.12	412.95	0.32	0.73
Max				0.37	0.37	1970	1.43	2.30
Min				0.00	0.02	28.30	0.01	0.30
SD				0.07	0.10	554.90	0.42	0.49
CV (%)				229.87	87.12	134.37	134.46	67.77

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
615	MB	U	15-30	0.110	0.072	53.2	0.162	0.4
615	MB	M	15-30	0.011	0.028	546.0	0.591	0.4
615	MB	L	15-30	0.046	0.092	47.0	0.078	0.7
Mean				0.06	0.06	215.40	0.28	0.50
Max				0.11	0.09	546.00	0.59	0.70
Min				0.01	0.03	47.00	0.08	0.40
SD				0.05	0.03	286.32	0.28	0.17
CV (%)				90.18	51.16	132.93	99.33	34.64
678	BT	U	15-30	0.004	0.036	93.0	0.076	1.4
678	BT	M	15-30	0.004	0.048	65.4	0.066	1.2
678	BT	L	15-30	0.005	0.090	67.1	0.058	0.6
680	BT	U	15-30	0.004	0.023	596.0	0.368	0.3
680	BT	M	15-30	0.004	0.039	210.0	0.124	0.5
680	BT	L	15-30	0.004	0.038	207.0	0.133	0.5
681	BT	U	15-30	0.004	0.048	50.7	0.028	0.1
681	BT	M	15-30	0.006	0.048	51.2	0.063	0.1
681	BT	L	15-30	0.004	0.046	48.7	0.052	0.2
684	BT	U	15-30	0.014	0.152	891.0	1.270	0.2
684	BT	M	15-30	0.004	0.053	306.0	0.265	0.2
684	BT	L	15-30	0.020	0.066	45.0	0.058	0.1
687	BT	U	15-30	0.014	0.056	38.9	0.035	0.1
687	BT	M	15-30	0.013	0.045	38.9	0.044	0.1
687	BT	L	15-30	0.034	0.049	41.6	0.023	0.4
688	BT	U	15-30	0.010	0.074	36.3	0.034	0.4
688	BT	M	15-30	0.010	0.095	88.5	0.094	0.4
688	BT	L	15-30	0.016	0.057	66.5	0.080	0.2
692	BT	U	15-30	0.015	0.070	113.0	0.146	0.3
692	BT	M	15-30	0.014	0.041	86.2	0.082	0.7
692	BT	L	15-30	0.008	0.058	104.0	0.062	0.5
703	BT	U	15-30	0.012	0.062	75.4	0.078	0.3
703	BT	M	15-30	0.010	0.038	47.2	0.046	0.2
703	BT	L	15-30	0.038	0.064	23.1	0.028	0.3
Mean				0.01	0.06	141.28	0.14	0.39
Max				0.04	0.15	891.00	1.27	1.40
Min				0.00	0.02	23.10	0.02	0.10
SD				0.01	0.03	201.67	0.25	0.33
CV (%)				79.96	44.81	142.75	183.73	84.85

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
727	AP	U	15-30	0.034	0.093	81.0	0.055	0.7
727	AP	M	15-30	0.010	0.048	86.1	0.124	0.8
727	AP	L	15-30	0.010	0.086	81.7	0.206	0.6
728	AP	U	15-30	0.022	0.053	47.9	0.120	0.5
728	AP	M	15-30	0.028	0.049	69.6	0.058	0.5
728	AP	L	15-30	0.070	0.071	78.0	0.217	0.4
730	AP	U	15-30	0.020	0.076	18.5	0.032	0.2
730	AP	M	15-30	0.011	0.051	41.7	0.131	0.5
730	AP	L	15-30	0.024	0.084	235.0	0.203	0.2
738	AP	U	15-30	0.013	0.076	64.8	0.058	0.4
738	AP	M	15-30	0.013	0.040	74.2	0.115	0.5
738	AP	L	15-30	0.010	0.041	81.5	0.138	0.4
739	AP	U	15-30	0.030	0.108	26.5	0.027	0.2
739	AP	M	15-30	0.014	0.066	52.9	0.041	0.1
739	AP	L	15-30	0.014	0.104	235.0	0.284	0.2
740	AP	U	15-30	0.014	0.132	45.7	0.172	0.4
740	AP	M	15-30	0.015	0.050	39.5	0.128	0.5
740	AP	L	15-30	0.147	0.086	65.3	0.066	0.7
743	AP	U	15-30	0.027	0.044	19.0	0.045	0.3
743	AP	M	15-30	0.043	0.089	14.6	0.015	0.5
743	AP	L	15-30	0.007	0.045	53.7	0.101	0.6
744	AP	U	15-30	0.010	0.061	70.3	0.077	0.4
744	AP	M	15-30	0.014	0.054	65.4	0.082	0.4
744	AP	L	15-30	0.014	0.074	83.9	0.092	0.5
746	AP	U	15-30	0.036	0.058	61.9	0.065	0.4
746	AP	M	15-30	0.014	0.051	90.9	0.046	0.5
746	AP	L	15-30	0.010	0.052	91.4	0.059	0.5
			Mean	0.02	0.07	73.19	0.10	0.44
			Max	0.15	0.13	235.00	0.28	0.80
			Min	0.01	0.04	14.60	0.02	0.10
			SD	0.03	0.02	51.78	0.07	0.17
			CV (%)	111.84	34.31	70.75	65.41	37.89

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
769	MM	U	15-30	0.008	0.086	92.7	0.069	0.5
769	MM	M	15-30	0.011	0.065	282.0	0.331	0.4
769	MM	L	15-30	0.008	0.054	90.0	0.102	0.3
781	MM	U	15-30	0.014	0.078	109.0	0.097	0.8
781	MM	M	15-30	0.009	0.076	146.0	0.161	0.9
781	MM	L	15-30	0.008	0.102	89.0	0.110	1.5
786	MM	U	15-30	0.046	0.187	62.7	0.031	0.3
786	MM	M	15-30	0.032	0.138	294.0	0.257	0.2
786	MM	L	15-30	0.008	0.034	53.8	0.050	0.1
791	MM	U	15-30	0.016	0.096	130.0	0.085	0.1
791	MM	M	15-30	0.039	0.084	31.6	0.015	0.2
791	MM	L	15-30	0.024	0.129	526.0	0.719	0.3
793	MM	U	15-30	0.058	0.046	39.9	0.020	0.3
793	MM	M	15-30	0.032	0.056	30.3	0.020	0.3
793	MM	L	15-30	0.018	0.105	362.0	0.345	0.3
			Mean	0.02	0.09	155.93	0.16	0.43
			Max	0.06	0.19	526.00	0.72	1.50
			Min	0.01	0.03	30.30	0.02	0.10
			SD	0.02	0.04	144.91	0.19	0.37
			CV (%)	72.21	44.68	92.93	117.30	85.76
798	FG	U	15-30	0.029	0.060	83.8	0.032	0.5
798	FG	M	15-30	0.031	0.072	146.0	0.100	0.3
798	FG	L	15-30	0.016	0.073	246.0	0.221	0.5
800	FG	U	15-30	0.014	0.058	77.8	0.025	0.5
800	FG	M	15-30	0.014	0.058	104.0	0.024	0.6
800	FG	L	15-30	0.031	0.077	59.1	0.036	0.6
			Mean	0.02	0.07	119.45	0.07	0.50
			Max	0.03	0.08	246.00	0.22	0.60
			Min	0.01	0.06	59.10	0.02	0.30
			SD	0.01	0.01	68.71	0.08	0.11
			CV (%)	38.41	12.96	57.52	106.79	21.91

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

Appendix 4. Results of micronutrient analysis from 42 benchmark sites across Alberta (15-30 cm depth) continued.

Site #	Eco-region	Slope Position	Depth (cm)	Molybdenum ³ (mg/kg) (0.004) ⁵	Nickel ³ (mg/kg) (0.004) ⁵	Silicon ³ (mg/kg) (0.02) ⁵	Zinc ³ (mg/kg) (0.002) ⁵	Selenium ⁴ (mg/kg) (0.1) ⁵
804	MG	U	15-30	0.017	0.146	215.0	0.151	0.3
804	MG	M	15-30	0.059	0.111	124.0	0.090	0.4
804	MG	L	15-30	0.096	0.173	43.4	0.034	0.6
806	MG	U	15-30	0.083	0.132	33.1	0.036	0.5
806	MG	M	15-30	0.029	0.161	359.0	0.328	0.5
806	MG	L	15-30	0.013	0.107	338.0	0.265	0.5
809	MG	U	15-30	0.076	0.067	66.6	0.024	0.3
809	MG	M	15-30	0.056	0.117	34.9	0.014	0.3
809	MG	L	15-30	0.019	0.091	198.0	0.162	0.3
812	MG	U	15-30	0.125	0.119	50.3	0.011	0.3
812	MG	M	15-30	0.106	0.093	37.4	0.013	0.3
812	MG	L	15-30	0.117	0.134	45.9	0.010	0.3
815	MG	U	15-30	0.036	0.047	44.5	0.018	0.3
815	MG	M	15-30	0.035	0.081	49.2	0.008	0.3
815	MG	L	15-30	0.038	0.136	282.0	0.230	0.4
823	MG	U	15-30	0.078	0.095	67.2	0.008	0.3
823	MG	M	15-30	0.064	0.129	245.0	0.192	0.2
823	MG	L	15-30	0.059	0.109	137.0	0.046	0.3
1828	MG	U	15-30	0.039	0.039	41.2	0.010	0.2
1828	MG	M	15-30	0.026	0.111	147.0	0.106	0.3
1828	MG	L	15-30	0.026	0.084	150.0	0.075	0.3
2828	MG	U	15-30	0.029	0.065	26.2	0.013	0.3
2828	MG	M	15-30	0.022	0.101	124.0	0.094	0.4
2828	MG	L	15-30	0.031	0.073	24.6	0.047	0.3
			Mean	0.05	0.11	120.15	0.08	0.34
			Max	0.13	0.17	359.00	0.33	0.60
			Min	0.01	0.04	24.60	0.01	0.20
			SD	0.03	0.03	102.55	0.09	0.10
			CV (%)	62.28	32.16	85.35	111.30	28.52

¹ 0.01 M Ca(NO₃)₂ extractable

² DTPA extractable

³ Hot water extractable

⁴ Total

⁵ Detection limit (mg/kg)

