SOIL NUTRIENT STUDY 2020

FINAL REPORT

BRITISH COLUMBIA

Ministry of Agriculture and Food

SOIL NUTRIENT STUDY 2020

FOR SELECTED AREAS ON VANCOUVER ISLAND, THE THOMPSON RIVER REGIONAL DISTRICT AND THE OKANGAN/SIMILKAMEEN

SHORT TITLE: SOIL NUTRIENT STUDY 2020

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B.C. Ministry of Agriculture and Food

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Disclaimer

SOIL NUTRIENT STUDY 2020

1 SUMMARY

In the fall of 2020 soil from three study areas in B.C. and across a range of commodities were sampled after harvest and analyzed for soil nitrogen, phosphorus, and other plant nutrients. More than 93% of all samples had nitrate concentrations below 100 kg ha^{-1} and more than 94% of all samples had extractable phosphorus concentrations below 200 ppm. About 20% of all samples had an extractable P content that exceeded 100 ppm.

Land under vegetable production had the highest post-harvest nitrate content compared to other commodities. Similarly, vegetable and berry systems had the highest extractable soil phosphorus levels. Most soil samples from land under vegetable production, and all samples from land under berry production came from the Vancouver Island study area. Consequently, mean soil nitrate and phosphorus concentration were higher in that study compared to the two other study areas.

Average soil nitrate concentrations were higher, and average extractable soil phosphorus concentration was lower on land for which cover cropping practices was reported compared to those for which cover cropping practices were either unknown or not reported. Average soil organic matter content on land for which cover crops practices was higher at the 0 - 15 cm sampling depth, but significantly lower at the 16 - 30 cm depth compared to land for which cover crop practices were either unknown or not reported

				Count
REGION	OKANAGAN	Geographic_Area	Cawston	4
			Central Okanagan	10
			Kelowna	31
			Lake Country	10
			Naramata	4
			Naramata Bench	1
			North Okanagan	3
			Oliver	2
			Osoyoos	3
			Penticton	3
			Similkameen	4
			South Okanagan	16
			Summerland	5
			Vernon	4
			West Kelowna	4
	TNRD	Geographic_Area	Ashcroft	8
			Black Pines	4
			Cache Creek	7
			Chase	1
			Douglas Lake	4
			Heffley Creek	8
			Kamloops	4
			Logan Lake	4
			Mclure	4
			Merritt	22
			Prichard	4
			Savona	6
			Spences Bridge	4
			Turtle Valley	4
			Walhachin	4
			Westwold	12
	VI	Geographic_Area	Black Creek	2
			Campbell River	3
			Comox	24
			Courtney	3
			Cowichan Valley	32
			Metchosin	12
			Nanaimo	5
			Nanoose	4
			Port Alberni	6
			Qualicum	2
			Saanich	20
			Sayward	2

Table 1 Sampling locations.

2 INTRODUCTION AND METHODS

In 2020, the B.C. Ministry of Agriculture and Food commissioned a soil nutrient survey in three areas with significant intensive agricultural production in B.C.: The southern half of the Thompson-Nicola Regional District (hereafter referred to as "TNRD"), the Okanagan and Similkameen ("Okanagan") and the southeastern part of Vancouver Island ("Vancouver Island" or "VI"). Please refer to *Figure 1* for a map with outlines of the study areas.

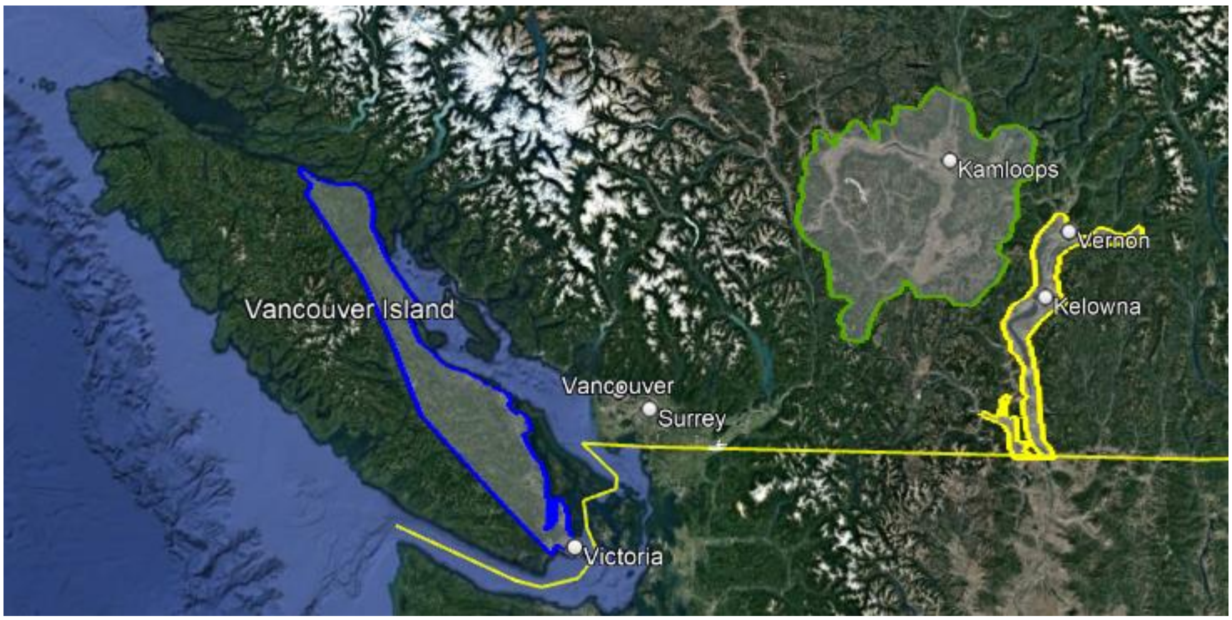

Figure 1 Study areas. The study area on Vancouver Island is outlined in blue (referred to as "Vancouver Island" in this report), the study area in the Thompson-Nicola Regional District is outlined in green ("TNRD"), and the study area in the Okanagan and Similkameen ("Okanagan").

A contractor and growers collected post-harvest soil samples from a total of 319 management units (MU)[1] in the survey areas, distributed as follows: 115 MUs were taken in the Vancouver Island study area, 100 MUs TNRD study area and 104 in the Okanagan study area (*Table 1*).

In the TNRD, contractors took the samples between 15th September and 1st October 2020 and on Vancouver Island between 7th October and 22 October 2020.In the Okanagan the approach was slightly different. Here, samples were collected by the producers themselves. Exact sampling dates were not recorded but sampling was completed late October (verbal communication by the contractor).

[1] For this study, a management unit ("MU") is defined as a field or a group of adjoining fields no larger than a total of 10 hectares (25 acres) that has similar soil, topography, and:

a) are not Organic soils (commonly referred to as peat or muck soils),
b) is managed uniformly (e.g., same, or similar crops, similar nutrient management, and crop rotation history),
c) receive application of nitrogen or phosphorus from fertilizer, manure, or other nutrient sources, and
d) belongs to a farm operation with a total land base larger than 2 ha (5 acres).

Samples from the Okanagan and the TNRD were submitted to A&L laboratories. Samples taken on Vancouver Island were analyzed by the environmental laboratory of the BC Ministry of Environment and Climate Change Strategy.

Sampling depth was 0 - 15 cm for general fertility (all macro-nutrients including nitrate-N and extractable P, some micro-nutrients, sodium, and pH) and, in addition, 16 - 30 cm only for nitrate-N (in a few cases, samples were also analyzed for other nutrients and properties at that depth). The general fertility test included all micronutrients (nitrogen in form of nitrate-N, phosphorus, potassium, sulfur, magnesium, and calcium), some micronutrients (namely Zinc, Manganese, Iron, Copper, and Boron), sodium and aluminum, organic matter, and pH. This report, however, focuses on nitrate-N and extractable phosphorus.

Phosphorus-extraction method at the A&L lab (used for the Okanagan and the TNRD) was Bray-1 and at the environmental lab (Vancouver Island) both Mehlich-3 (Vancouver Island) and Bray 1 results were available. The results were converted into the Kelowna extraction[2] method by using the regressions proposed in the BC Ministry of Agriculture and Food factsheet *Understanding Different Soil Test Methods* (2010). In the case of the results from the environmental lab, the average was calculated after converting the results of the Bray-1 and Mehlich 3 P extraction into Kelowna P because the conversion did not result in the same Kelowna values.

Nitrate values of the two depths were summed and then multiplied by 2 to convert the ppm value into kg ha^{-1}. This is based on a simplified assumption of a bulk density of about 1.33 Mg t^{-1} which would, for example, be typical for an uncompacted loamy sand with organic matter content > 7%, or an uncompacted loam with little organic matter. However, bulk density was not measured in this study and the true value may differ from case to case. In fact, soil bulk density of intensively farmed agricultural soils in B.C. is frequently higher than 1.33 Mg t^{-1} and consequently, the “true” nitrate content may be somewhat higher in those cases.

The BC Ministry of Agriculture and Food did not receive any individual soil test results to protect the confidentiality of the information. Instead, the contractor provided the Ministry with aggregated data in a spreadsheet without specifying exact locations and without information that could help to identify a farm operation or their owners.

[2] The Kewlona method is described in Van Lierop, W. 1988. Determination of available phosphorus in acid and calcareous soils with the Kelowna multiple-element extractant. Soil Science, 146: 284 - 291

3 RESULTS

3.1 Post-Harvest Soil Nitrate

3.2 All regions and commodities

The average nitrate-N content[3] was 37.5 kg ha^{-1} and the median was 24.0 kg ha^{-1}. About 93.1% of all samples showed a nitrate content of less than 100 kg ha^{-1}; less than 3% exceeded 150 kg ha^{-1} (*Table 2, Figure 2*). A post harvest soil nitrate content exceeding 100 kg ha^{-1} may trigger the requirement of a nutrient management plan prepared by an experienced person (potentially the grower), and the threshold of 150 kg ha^{-1} may require a nutrient management plan prepared by a qualified professional.[4]

Statistics

NITRATE (O-30 CM) (kg ha)

N	Valid	305
	Missing	14
Mean		37.460
Std. Error of Mean		2.5395
Median		24.000
Std. Deviation		44.3513
Minimum		.0
Maximum		454.0
Percentiles	25	14.000
	50	24.000
	75	46.000

93.1% < 100 kg ha^{-1}

97.7% < 150 kg ha^{-1}

Table 2 Statistics describing nitrate-N content of all study areas and commodity groups

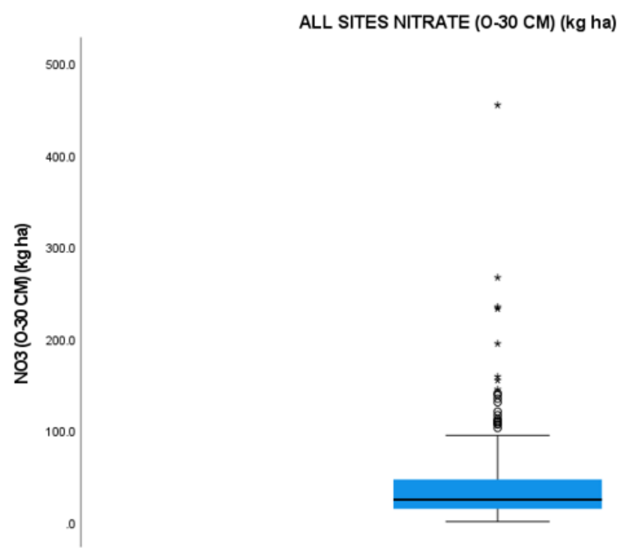

Figure 2 Boxplot illustrating the distribution of soil nitrate value for all three study areas.

[3] Ammonium acetate extractable

[4] See section 57 of the Code of Practice for Agricultural Environmental Management (https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/8_2019#section56)

3.3 Post harvest soil nitrate: By region, all commodities

The average nitrate-N content in the samples of each study area was quite similar although the average soil nitrate-N content in samples from the Okanagan (34.7 kg ha^{-1}) were, on average, somewhat lower than those in the TRND (38.3 kg ha^{-1}) and on Vancouver Island (38.9 kg ha^{-1}). Despite some extreme outliers, the proportion of low values is larger than that of high values. In other words, the distribution is positively skewed; more so for the Okanagan observations than those from the other study areas. The *median* nitrate content in the Okanagan samples (18.0 kg ha^{-1}) is, therefore, substantially smaller than that of the TNRD (26.0 kg ha^{-1}) and Vancouver Island (25.4 kg ha^{-1}) (*Table 3, Figure 3*).

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	90
	Missing	14
Mean		34.744
Std. Error of Mean		6.1402
Median		18.000
Std. Deviation		58.2512
Minimum		4.0
Maximum		454.0
Percentiles	25	10.000
	50	18.000
	75	36.000

a. REGION = OKANAGAN

94.4% < 100 kg ha^{-1}
96.7% < 150 kg ha^{-1}

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	100
	Missing	0
Mean		38.260
Std. Error of Mean		3.6785
Median		26.000
Std. Deviation		36.7846
Minimum		6.0
Maximum		232.0
Percentiles	25	16.000
	50	26.000
	75	44.000

a. REGION = TNRD

92.0% < 100 kg ha^{-1}
97.0% < 150 kg ha^{-1}

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	115
	Missing	0
Mean		38.889
Std. Error of Mean		3.5051
Median		25.400
Std. Deviation		37.5879
Minimum		.0
Maximum		234.0
Percentiles	25	13.000
	50	25.400
	75	54.000

a. REGION = VI

93.0% < 100 kg ha^{-1}
99.1% < 150 kg ha^{-1}

Table 3 Soil nitrate-N content of samples by study area

This can be considered as “good news” as generally speaking, with a few exceptions, nitrate-N levels are relatively low and winter leaching of nitrate is generally not a concern.

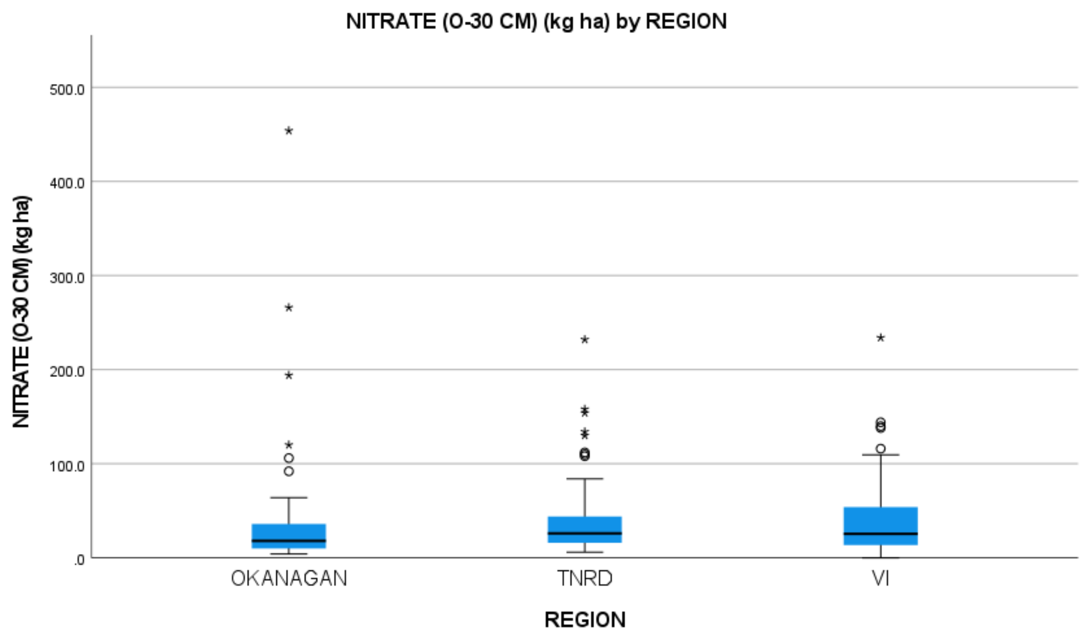

Figure 3 Boxplots comparing soil nitrate-N of the three study areas.VI = Vancouver Island.

3.4 Post harvest soil nitrate: By commodity group, all regions

Due to the limited number of observations for some commodities, commodities were grouped into categories. The number of valid observations (i.e., number of samples used for this analysis) are distributed as follows (see also *Table 4*)

- Berries (4 valid observations)
- Forage and Pasture (143)
- Fruit (58) (pears, apples, cherries)
- Grape (52)[5]
- Vegetable (33) (excluding potatoes[6])
- Other (15) which includes potato, grain and crops not specified by the contractor or grower

[5] The total number of observations in this commodity group is 58. However, 6 samples – all from the Okanagan study area – were taken only to a depth of 15 cm and thus, were not included in the calculation of post-harvest nitrogen statistics (but for the calculation of extractable soil phosphorus statistics).

[6] There was only one MU that reported potato and one that reported potato and other vegetables. The former was included into the “other” category, the latter into the vegetable commodity group)

COMMODITY GROUP / REGION	OKANAGAN	TNRD	VANCOUVER ISLAND	Total (commodity group)
GRAPE	41	1	16	58
FRUIT	63	2	1	66
VEGETABLE	0	6	27	33
FORAGE AND PASTURE	0	87	56	143
BERRY	0	0	4	4
OTHER	0	4	11	15
Total (region)	104	100	115	319

Table 4 Numbers of samples by commodity group and study area.

Highest average post-harvest soil nitrate content was found for vegetables (65.9 kg ha^{-1}) leaving far behind the runner-ups berry and fruits (both 42.6 kg ha^{-1}). Lowest mean nitrate content was observed in fields under grape production (22 kg ha^{-1}). Less than 79% of the MUs in vegetable production showed mean nitrate values below 100 kg ha^{-1} and almost 10% of the observations exceeded 150 kg ha^{-1}. (*Table 5, Figure 4*)

The soil nitrate-content values found for all commodities, except for berry, had outliers. In the commodity groups “fruit” and “forage and pasture”, three of the outliers were extreme outliers[7]. After removing all outliers from the values for all commodity groups, all nitrate values were below 100 kg ha^{-1} except for vegetable.

Samples from the Okanagan where almost exclusively from land under grape or fruit production (*Table 4*). The low nitrate-N content in samples collected from land under those commodity groups compared to other commodities explains, therefore, why the average and median nitrate-N content of all samples collected in the Okanagan study area are lower than those in the two other study areas.

Within the vegetable commodity group, the mean nitrate content in the soil was substantially higher in the TNRD (100.3 kg ha^{-1}) than on Vancouver Island (57.9 kg ha^{-1}). However, there were only 6 data points from the TNRD but 27 data points from Vancouver Island. No vegetable data were available for this survey for the Okanagan.

[7] SPSS defines extreme outliers as data points that are larger (or smaller) than 3 times the interquartile range

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	4
	Missing	0
Mean		42.60000000
Std. Error of Mean		19.14889031
Median		32.20000000
Std. Deviation		38.29778061
Minimum		12.00000000
Maximum		94.00000000
Percentiles	25	12.70000000
	50	32.20000000
	75	82.90000000

a. NEW CROP CATEGORY 2 = BERRY

100% < 100 kg ha^{-1}

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	143
	Missing	0
Mean		33.99496503
Std. Error of Mean		2.447839036
Median		25.40000000
Std. Deviation		29.27189745
Minimum		.0000000000
Maximum		154.0000000
Percentiles	25	15.20000000
	50	25.40000000
	75	44.00000000

a. NEW CROP CATEGORY 2 = FORAGE AND PASTURE

95.1% < 100 kg ha^{-1}
99.3% < 150 kg ha^{-1}

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	58
	Missing	8
Mean		42.59310345
Std. Error of Mean		9.328931594
Median		21.00000000
Std. Deviation		71.04702634
Minimum		4.000000000
Maximum		454.0000000
Percentiles	25	10.00000000
	50	21.00000000
	75	47.00000000

a. NEW CROP CATEGORY 2 = FRUIT

91.4% < 100 kg ha^{-1}
94.8% < 150 kg ha^{-1}

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	52
	Missing	6
Mean		22.05692308
Std. Error of Mean		2.806079017
Median		15.00000000
Std. Deviation		20.23492356
Minimum		.7000000000
Maximum		106.0000000
Percentiles	25	8.100000000
	50	15.00000000
	75	35.70000000

a. NEW CROP CATEGORY 2 = GRAPE

98.1% < 100 kg ha^{-1}
100% < 150 kg ha^{-1}

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	15
	Missing	0
Mean		40.78666667
Std. Error of Mean		7.919895783
Median		34.80000000
Std. Deviation		30.67362447
Minimum		7.600000000
Maximum		130.0000000
Percentiles	25	22.40000000
	50	34.80000000
	75	60.00000000

a. NEW CROP CATEGORY 2 = OTHER

93.3% < 100 kg ha^{-1}
100% < 150 kg ha^{-1}

Statistics[a]

NITRATE (O-30 CM) (kg ha)

N	Valid	33
	Missing	0
Mean		65.58727273
Std. Error of Mean		10.12111855
Median		49.00000000
Std. Deviation		58.14139958
Minimum		10.60000000
Maximum		234.0000000
Percentiles	25	21.79000000
	50	49.00000000
	75	87.00000000

a. NEW CROP CATEGORY 2 = VEGETABLE

78.8% < 100 kg ha^{-1}
90.9% < 150 kg ha^{-1}

Table 5 Statistics describing soil nitrate-N (kg ha^{-1}) content by commodity group

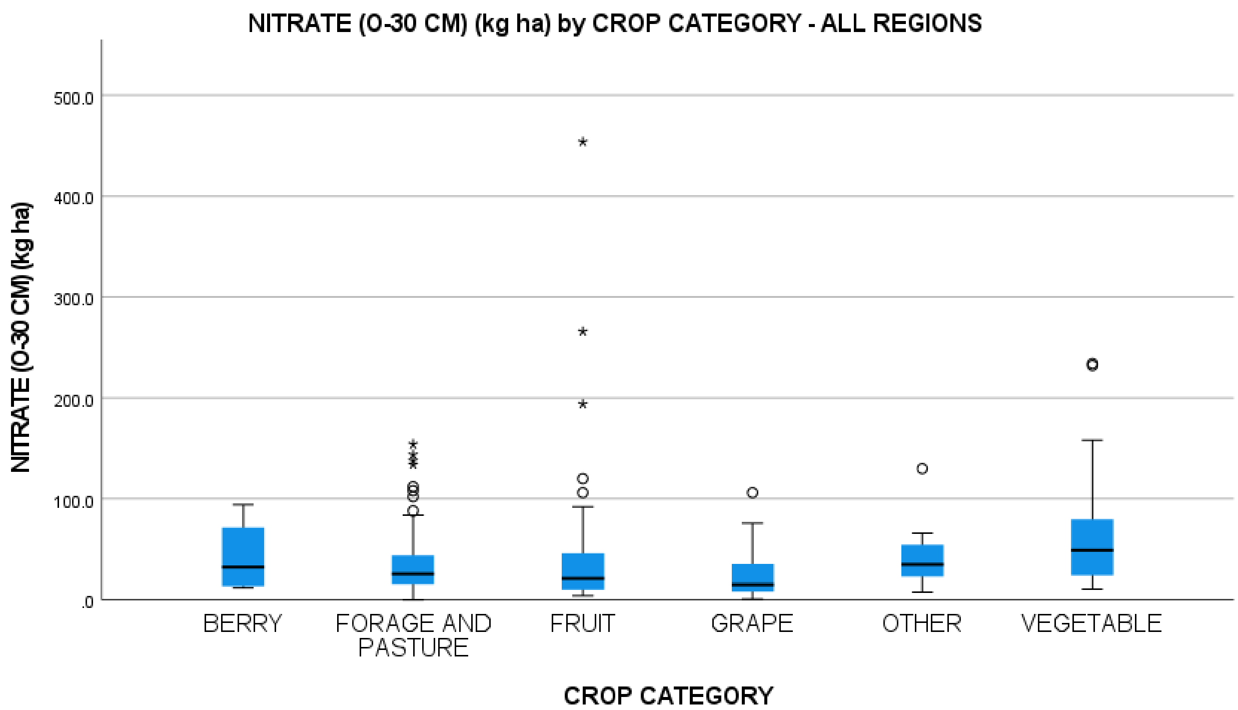

Figure 4 Boxplots comparing soil nitrate-N by commodity group.

3.5 Soil Phosphorus

3.5.1 Soil Phosphorus: All regions, all commodities

The average extractable soil phosphorus content (Kelowna method) for all regions and across all commodities was 69.6 ppm; median P content is 46.6 ppm. Again, it means that a few high values or outliers skew the distribution towards a high average. About 80% of all data points were below 100 ppm, about 95% below 200 ppm. The extractable P content of 12 samples exceeded 300 ppm. (*Table 6, Figure 5*). Extractable soil phosphorus exceeding 200 ppm or 100 ppm are threshold values that may trigger the requirement for a nutrient management plant in some areas of B.C.[8]

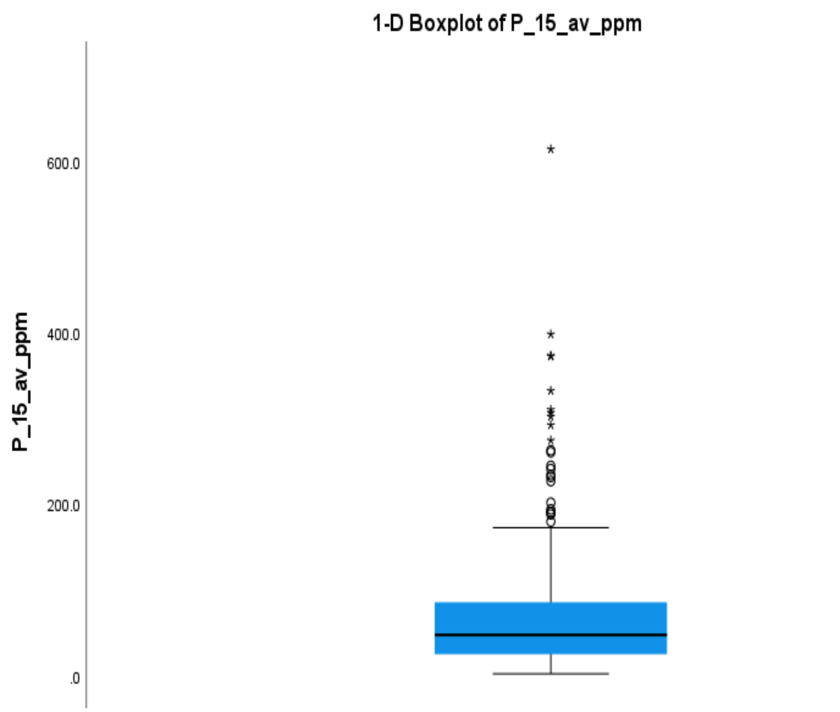

Figure 5 Boxplot of the extractable soil P values (all regions and commodities. P_15_av_ppm means average extractable phosphorus (ppm).

Statistics

P_15_av_ppm

N	Valid	319
	Missing	0
Mean		69.601
Std. Error of Mean		4.1636
Median		46.620
Std. Deviation		74.3645
Minimum		1.3
Maximum		613.2
Percentiles	25	23.680
	50	46.620
	75	85.100

79.9% < 100 ppm
94.4% < 200 ppm
97.5% < 300 ppm

Table 6 Extractable phosphorus content (ppm) of all regions and commodity groups. P_15_av_ppm means average extractable phosphorus (ppm).

3.5.2 Soil Phosphorus: By region, all commodities

Highest average extractable soil phosphorus content is found on Vancouver Island (97.0 ppm), followed by the Okanagan (64.4 ppm) and the TNRD (43.5 ppm). Only 65% of all data

[8] See amendments to the Code of Practice for Agricultural Environmental Management (https://www.bclaws.gov.bc.ca/civix/document/id/crbc/crbc/8_2019)

in the Vancouver Island study area were below 100 ppm, whereas 85% in the Okanagan and 92% in the TNRD were below that threshold. The Okanagan showed, relative to the two other regions, a more evenly distributed frequency of extractable P values and thus, a

Statistics[a]

P_15_av_ppm

N	Valid	104
	Missing	0
Mean		64.423
Std. Error of Mean		3.7467
Median		60.310
Std. Deviation		38.2092
Minimum		10.4
Maximum		187.2
Percentiles	25	32.930
	50	60.310
	75	83.990

a. REGION = OKANAGAN

Statistics[a]

P_15_av_ppm

N	Valid	100
	Missing	0
Mean		43.490
Std. Error of Mean		4.9428
Median		30.710
Std. Deviation		49.4283
Minimum		5.2
Maximum		301.2
Percentiles	25	18.500
	50	30.710
	75	44.770

a. REGION = TNRD

Statistics[a]

P_15_av_ppm

N	Valid	115
	Missing	0
Mean		96.989
Std. Error of Mean		9.6035
Median		64.640
Std. Deviation		102.9856
Minimum		1.3
Maximum		613.2
Percentiles	25	27.240
	50	64.640
	75	131.700

a. REGION = VI

84.6% < 100 ppm	92.0% < 100 ppm	65.0% < 100 ppm
100% < 200 ppm	97.0% < 200 ppm	87.0% < 200 ppm
	99.0% < 300 ppm	93.9% < 300 ppm

Table 7 Extractable phosphorus (ppm) by study area (VI = Vancouver Island). P_15_av_ppm means average extractable phosphorus (ppm).

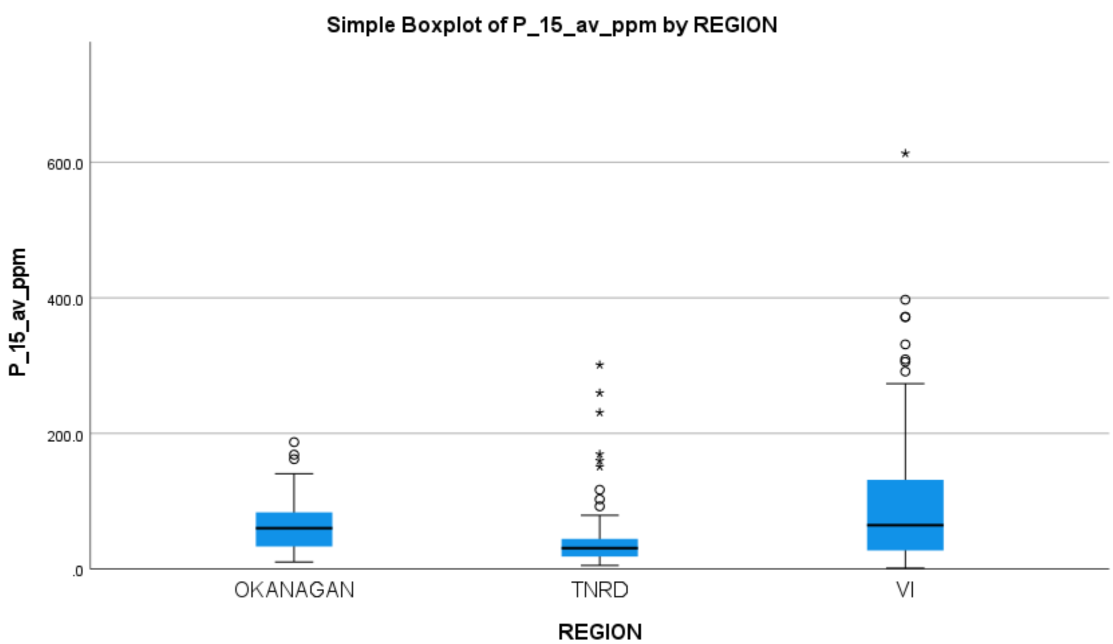

Figure 6 Boxplots comparing soil nitrate-N between the three study areas.VI = Vancouver Island. P_15_av_ppm means average extractable phosphorus (ppm).

3.5.3 Soil Phosphorus: By commodities, all regions

Highest mean extractable P value is found in fields where berries are grown (127.1 ppm), closely followed by values found in soil of vegetable fields (126.2 ppm). Lowest mean extractable P value is observed in forage and pasture fields (58.1 ppm) and fruit orchards (59.7 ppm).

Only 50% of the berry fields, and 60.6% of the vegetable samples have extractable soil P values below 100 ppm. All soil samples from fruit and grape contained less than 200 ppm extractable P but other commodities had soil samples with extractable P concentrations that exceeded that threshold value.

However, things are somewhat different when we compare the *median* P content of land under grape production with that from land under vegetable production in this study. The median value can be seen as the value that is most frequently found in a batch ("population") of samples. With other words, it is the value that represents the more "typical" soil under a production system or in a certain area. Median values are also less susceptible to the influence of outliers than average values. In the case of this study, the average P concentration in soils under vegetable production is greater than the median P concentration because of a few extreme outliers. However, despite the relatively high average, we are more likely to find soil samples with P concentrations closer to the median value.

When median and average value are similar, high- and low-value cancel out each other or there are no "real" outliers". The latter is the case of the P concentration of samples from land under grape production. Therefore, while the average of the P concentration in soils under vegetation is greater than that of soils under grape production in this study, the "typical" P concentration under the soil of the former (vegetable) is slightly lower than that of soils under the latter.

Most of the samples from land under vegetable and all samples from land under berry production came from the VI study area and accounted for 37% of all samples from that area (*Table 4*). The two commodity groups also had the highest P concentration in the soil samples which explains why soil samples from VI had the highest average P concentration compared to the other study areas.

3.6 Other Observations

A correlation matrix was produced to understand whether some statistical relationship can be detected between soil nitrate, extractable soil P and other elements or soil properties that were reported in the soil test.

There was not significant correlation between Kelowna extractable soil P and soil nitrate, nor did extractable soil P or soil nitrate correlate with any other nutrients. There was also no significant (at the 0.1 level) correlation between all other measured nutrient concentration with a few exceptions, notably

- a negative correlation between soil organic matter (OM) and pH
- a positive correlation between OM and Fe
- a negative correlation between pH and Fe
- a positive correlation between Mg and Ca, and Mg and Na

It was interesting to note, however, that samples from land under (reported) **cover-cropping** practice (all regions and commodities) had a higher average nitrate content (38.9 kg ha^{-1}) but lower extractable P content (66.1 ppm) compared to fields without cover crops (35.1 kg ha^{-1} and 75.1 ppm, respectively). The differences were, however, not significant statistically (at the p= 0.1 level). It can be hypothesized that the cover crop had reduced nitrate leaching and made the nitrate available later as the result of root and residue decomposition. The reasons for reduced P under cover crop is less obvious. In fact, the pH where cover cropping was practiced was lower (pH 6.2) compared to land without cover cropping practice (pH 7.1) which would theoretically suggest a slightly reduced availability in the latter case. Perhaps, P had been in a less available (organic) form under cover crop than in fields without cover crop practice.

Management units with cover cropping practices had, on average, a higher soil organic matter content (7.5 %) compared to fields without cover cropping practice (5.2 %) for samples taken at the 0 – 15 cm depth. The difference was significant at the p = 0.001 level. The opposite was, however, true when comparing a sampling depth of 16 – 30 cm with a mean soil organic matter content of 2.0 % under cover-cropping vs 2.3 % with no cover crops. Here, too, the difference was statistically significant but only at the p=0.1 level.

Statistics[a]

P_15_av_ppm

N	Valid	4
	Missing	0
Mean		127.065
Std. Error of Mean		52.0903
Median		99.880
Std. Deviation		104.1806
Minimum		35.0
Maximum		273.5
Percentiles	25	45.190
	50	99.880
	75	236.125

a. NEW CROP CATEGORY 2 = BERRY

50% < 100 ppm
75% < 200 ppm
100% < 300 ppm

Statistics[a]

P_15_av_ppm

N	Valid	143
	Missing	0
Mean		58.153
Std. Error of Mean		5.5865
Median		33.300
Std. Deviation		66.8043
Minimum		3.2
Maximum		309.3
Percentiles	25	18.500
	50	33.300
	75	67.900

a. NEW CROP CATEGORY 2 = FORAGE AND PASTURE

82.5% < 100 ppm
94.4% < 200 ppm
97.4% < 300 ppm

Statistics[a]

P_15_av_ppm

N	Valid	66
	Missing	0
Mean		59.654
Std. Error of Mean		5.1615
Median		48.100
Std. Deviation		41.9321
Minimum		7.0
Maximum		187.2
Percentiles	25	28.675
	50	48.100
	75	79.180

a. NEW CROP CATEGORY 2 = FRUIT

87.9% < 100 ppm
100.0% < 200 ppm

Statistics[a]

P_15_av_ppm

N	Valid	58
	Missing	0
Mean		70.326
Std. Error of Mean		4.7024
Median		72.150
Std. Deviation		35.8125
Minimum		1.3
Maximum		145.7
Percentiles	25	42.180
	50	72.150
	75	95.375

a. NEW CROP CATEGORY 2 = GRAPE

77.6% < 100 ppm
100.0% < 200 ppm

Statistics[a]

P_15_av_ppm

N	Valid	15
	Missing	0
Mean		79.823
Std. Error of Mean		23.8904
Median		50.760
Std. Deviation		92.5269
Minimum		8.1
Maximum		371.5
Percentiles	25	25.870
	50	50.760
	75	69.040

a. NEW CROP CATEGORY 2 = OTHER

80.0% < 100 ppm
93.3% < 200 ppm
93.3% < 300 ppm*
*(one obs = 371.5)

Statistics[a]

P_15_av_ppm

N	Valid	33
	Missing	0
Mean		126.216
Std. Error of Mean		24.6025
Median		70.300
Std. Deviation		141.3308
Minimum		3.4
Maximum		613.2
Percentiles	25	20.745
	50	70.300
	75	196.900

a. NEW CROP CATEGORY 2 = VEGETABLE

60.6% < 100 ppm
75.8% < 200 ppm
87.9% < 300 ppm

Table 8 Extractable phosphorus (ppm) by commodity group. P_15_av_ppm means average extractable phosphorus (ppm).

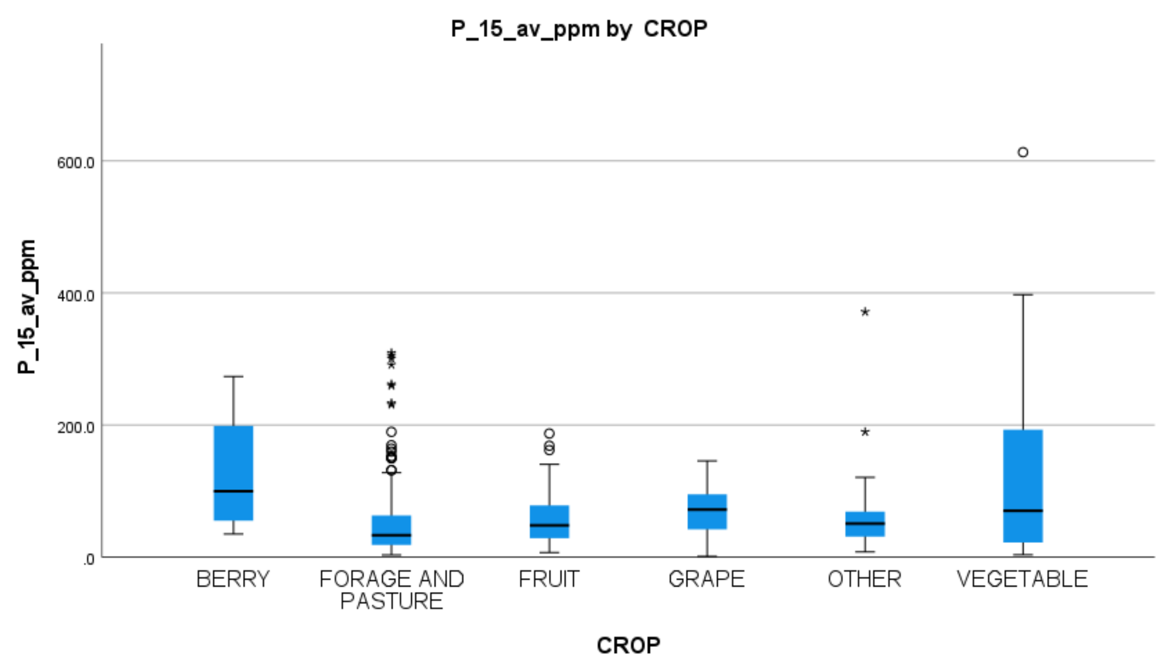

Figure 7 Boxplots comparing soil phosphorus content by commodity groups. P_15_av_ppm means average extractable phosphorus (ppm).

4 DISCUSSION AND CONCLUSION

Nitrate-N concentrations and (Kelowna) extractable soil P concentrations were, in most cases, well within the limits which could trigger the requirement for a nutrient management plan under Code of Practice for Agricultural Environmental Management. Less than 7% of the nitrate-N values and less than 6% of the extractable soil P values exceeded 100 kg ha^{-1} or 200 ppm, respectively. However, more than 21% of all samples exceeded the extractable soil P threshold of 100 ppm which may, in future, trigger the need for a nutrient management plan in some areas of B.C..

The distribution of the values is characterized by median values that are even lower than the average values and by high-value outliers. With other words, the values that exceed the regulatory thresholds are often not representative for a commodity or area. Furthermore, many of these outliers are extremely high which can only be explained by human error during sampling. For example, at least in one case, it could be established that soil was sampled withing a few hours after the application of manure. There are also differences in the analysis methods used by the two laboratories where the soil was tested for that study. However, it can be safely assumed that this difference will probably not impact the “big picture” substantially.

However, a relatively high number of high nitrate and P values was observed for vegetable production systems and for P values in the forage and pasture production system compared to other commodities. Strategies and programs to improve nutrient application and use efficiencies may consider prioritizing those two commodity sectors. It also necessary to understand whether values are on an upward or downward trend which can, of course, not be established by a one-time survey.