Results from the 2012 Fraser Valley Soil Nutrient Study – Vegetable

Nutrient Management Factsheet

January 2014 – Order Reference No. 631.500-12

Revised December 2015

Introduction

As a follow-up to the 2005 Fraser Valley Soil Nutrient Study[1] (FVSNS), soil samples were collected from 177 agricultural fields in the fall of 2012 to measure residual nitrogen (N), phosphorus (P) and potassium (K). The 2012 FVSNS was designed to monitor post-harvest soil nutrient status in comparison to 2005 results, which brought attention to accumulations of soil N, P and K. Sampling occurred in six study regions from West Delta to East Chilliwack, and from six different crop groups. This factsheet provides selected results from the vegetable fields sampled in 2012, with comparison to the 2005 vegetable findings.

Context – Weather during the study years

Weather conditions affect the amount, timing and release of plant-available forms of N and P in to the soil, which can be subsequently detected with soil testing. This is especially true for soil N, as mineralization rates are very responsive to weather conditions. Warmer weather and optimal soil moisture favour higher residual soil NO_3-N and soil test P levels. Excessive moisture received can lead to nutrient leaching from the soil profile, and subsequent underestimation of residual nutrient levels. As a result of this, it is important to note weather conditions when interpreting results for the 2005 and 2012 study years. Most notably, weather during the vegetable sampling period was cooler and wetter in 2005 than in 2012 (Table 1).

Table 1. Weather conditions in the Lower Fraser Valley relative to the long-term average (Environment Canada) and during the sampling periods in 2005 and 2012. Precipitation ranges represent the variation from West Delta to Abbotsford.

Year	Pre-season	Growing season	Sampling period	Sampling period weather
2005	Wet winter	Warm spring Typical summer	Sep 22 – Oct 31	11.6°C avg. air temp 40-145 precipitation
2012	Typical	Cool and wet spring/early summer Hot and dry late summer	Aug 31 – Oct 9	14.9°C avg. air temp 5-7 mm precipitation

How did vegetables compare to other commodities?

Compared to the other commodities sampled in 2012, vegetable fields tended to have high soil test results for NO_3-N and P, and average results for NH_4-N and K (Table 2). Sampling of the 177 fields in the Soil Study was not evenly distributed amongst the six regions and crop groups, and therefore results must be interpreted with caution. There were 30 vegetable fields sampled in 2012: 15 in West Delta and 15 in the Sumas area of Abbotsford.

Table 2. Mean residual soil nitrate (NO_3-N), ammonium (NH_4-N), soil test phosphorus (P) and soil test potassium (K) 0-30 cm values by crop for the 2012 Fraser Valley Soil Nutrient Study. The number of fields sampled per crop is represented by 'n'.

Crop	n	NO_3-N (kg/ha to 30 cm)	NH_4-N (kg/ha to 30 cm)	Kelowna[1] – P (kg/ha to 30 cm)	Kelowna – K (kg/ha to 30 cm)
Forage grass	45	66	17	415	551
Forage corn	31	90	11	540	833
Vegetables	30	109	14	642	553
Blueberries[2]	30	140	20	482	470
Raspberries[2]	19	78	14	1025	589
Nursery	22	71	16	381	565

[1] 'Kelowna' refers to the soil extraction method used to determine soil P and K concentrations.

[2] Blueberry and raspberry fields were only sampled within the cane/bush rows and dripline, which may have introduced a slight bias towards higher results on a kg/ha basis than other crops.

How did vegetables fields compare in the Valley in 2012?

For the most part, post-harvest soil nutrient status was higher in Sumas vegetable fields than those in West Delta. Average residual soil N (NO_3-N and NH_4-N) was higher in Sumas than West Delta (**Figure 1**, NH_4-N not shown), as was soil P (**Figure 2**). Nearly twice as many fields in Sumas than Delta were manured, which may have resulted in higher N and P values in Sumas. Soil K was higher in West Delta (**Figure 3**), which was expected due to the finer-textured soils in Delta.

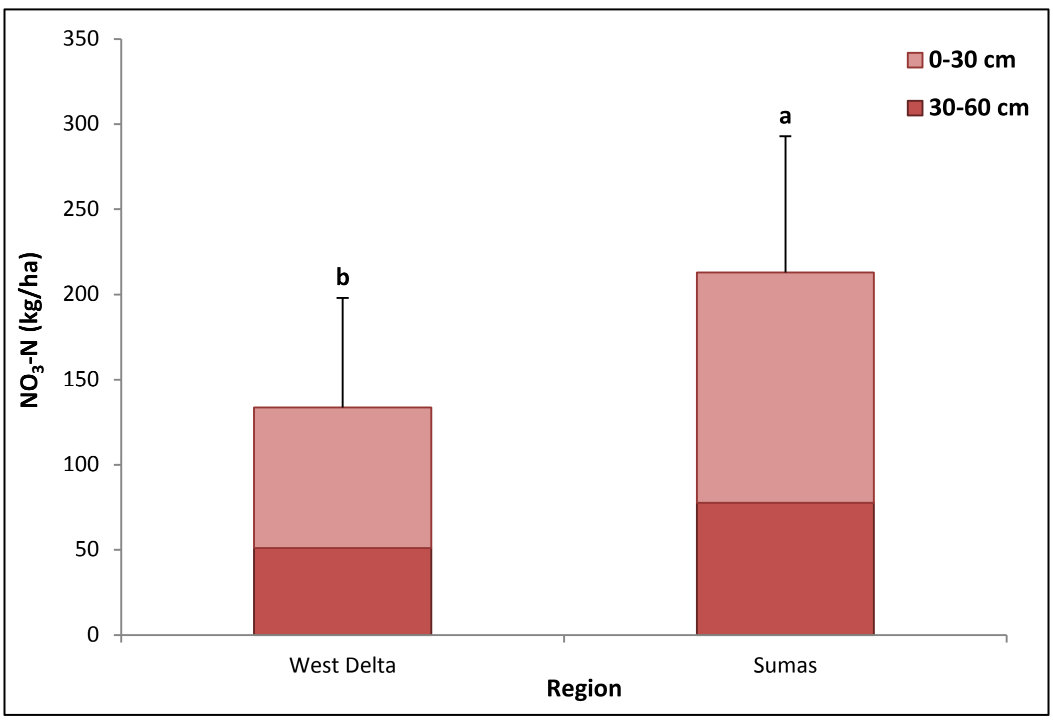

Figure 1. Mean residual soil nitrate (NO_3-N) values in vegetable fields by sample region in 2012. Regions with the same letters are not significantly different at the 5% level for 0-60 cm. Black bars indicate standard deviation. There were 15 fields sampled in each region.

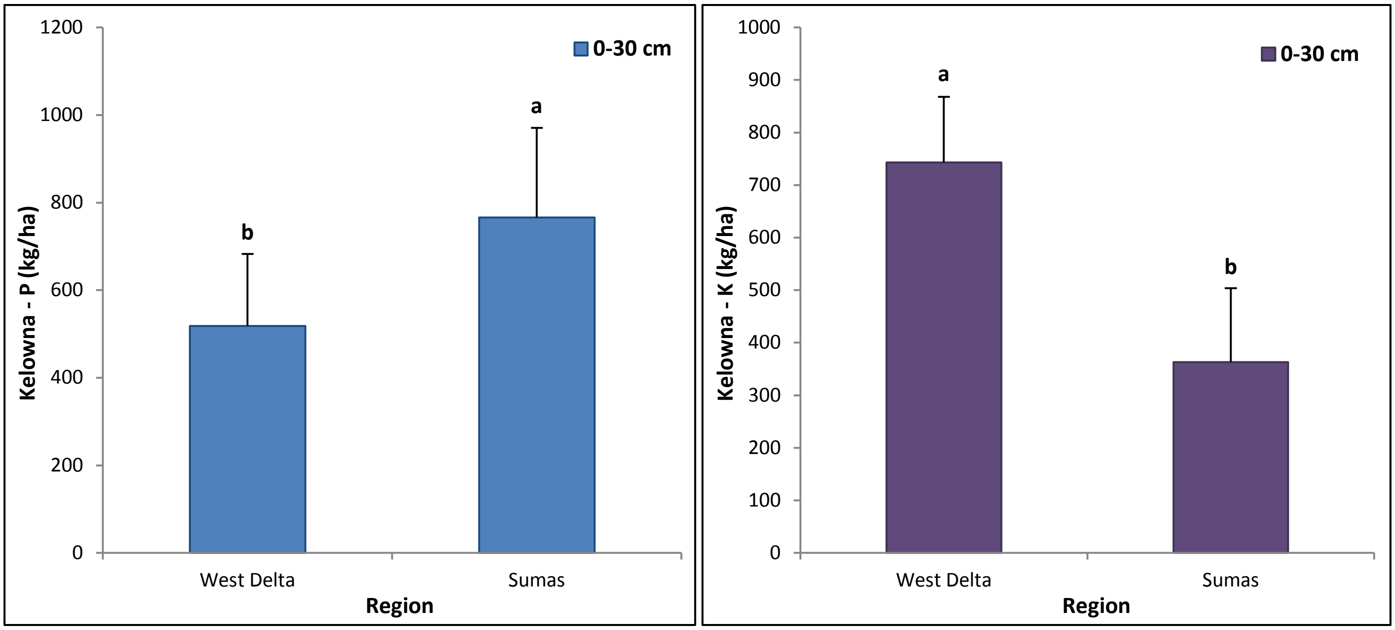

Figure 2 & 3. Mean soil test P and K (Kelowna equivalent) values in vegetable fields by sample region in 2012. Regions with the same letters are not significantly different at the 5% level. Black bars indicate standard deviation. There were 15 fields sampled in each region.

What do 2012 results mean agronomically?

In the Fraser Valley it is assumed that all residual soil NO_3-N will be lost over the winter due to leaching and denitrification[1]. In contrast, P and K are fairly stable in the soil and little change in their concentrations is expected between fall and the following spring[1]. General agronomic targets for soil P and K in the Kelowna-extraction method equivalency are 30-100 ppm P and 150-250 ppm K at the 0-15 cm sample depth[3,4,5]. In 2012, Kelowna-P exceeded the agronomic target and averaged 160 ppm in West Delta and 210 ppm in Sumas at 0-15 cm. Kelowna-K averaged 230 ppm in West Delta and 100 ppm in Sumas. Phosphorus levels over 75 ppm and K levels over 200 ppm are considered very high or excessive, and added fertilizer is unlikely to benefit crops for one or more years. Although P and K are fairly immobile in the soil, nutrient losses to the environment are possible through surface runoff and leaching into drainage systems. For additional information see the Nutrient Management resources in this document.

How did vegetable results compare with 2005 FVSNS?

When comparing **all fields** sampled in 2005 (28 fields) and 2012 (30 fields), only soil P was significantly different between the sample years (**Table 3**). Soil test P stayed fairly constant between the two study years in West Delta, but increased significantly in Sumas from 2005 to 2012.

The same numbers of manured fields were sampled in Sumas in both years, but manure application rates may have been higher in 2012. Sumas vegetable fields were also sampled later in the season in 2005, and heavy rains could have resulted in soil P losses.

Similarly, residual soil NO_3-N tended to be higher in 2012 (**Table 3**), but the regions behaved differently in the two years. Soil NO_3-N tended to decrease from 2005 to 2012 in West Delta, but increased dramatically in Sumas (**Figure 4**). The 2005 results in Delta varied widely, and the mean was skewed by a few fields with substantially higher soil NO_3-N. The extreme change in soil NO_3-N in Sumas between years is likely due to sampling conditions. In 2005 a total of 245 mm of rain fell in the Sumas area between September 1st and the end of the vegetable sampling period, in comparison to only 7 mm of rain in 2012. Considering that 125 mm of cumulative rainfall (from September 1st) is expected to move soil NO_3-N below the 0-30 cm depth[2], the 2005 Sumas results are likely underestimated.

In contrast to N and P, soil K remained constant between the study years in both regions (**Table 3**).

When comparing **the same 18 fields** sampled in 2005 and 2012, the soil N, P and K trends were very similar to those explained above.

Table 3. Mean, median and maximum soil nitrate (NO_3-N), phosphorus (P) and potassium (K) values in vegetable fields from the 2005 and 2012 Fraser Valley Soil Nutrient Study. There were 28 fields sampled in 2005 and 30 fields sampled in 2012.

	NO_3-N (kg/ha to 30 cm)		Kelowna – P (kg/ha to 30 cm)		Kelowna – K (kg/ha to 30 cm)	
Year	2005	2012	2005	2012	2005	2012
Mean	73 a[1]	109 a	469 b	642 a	584 a	553 a
Median	32	83	478	653	589	561
Maximum	375	253	671	1179	1360	949

[1] Means with the same letters for each nutrient are not significantly different at the 5% level.

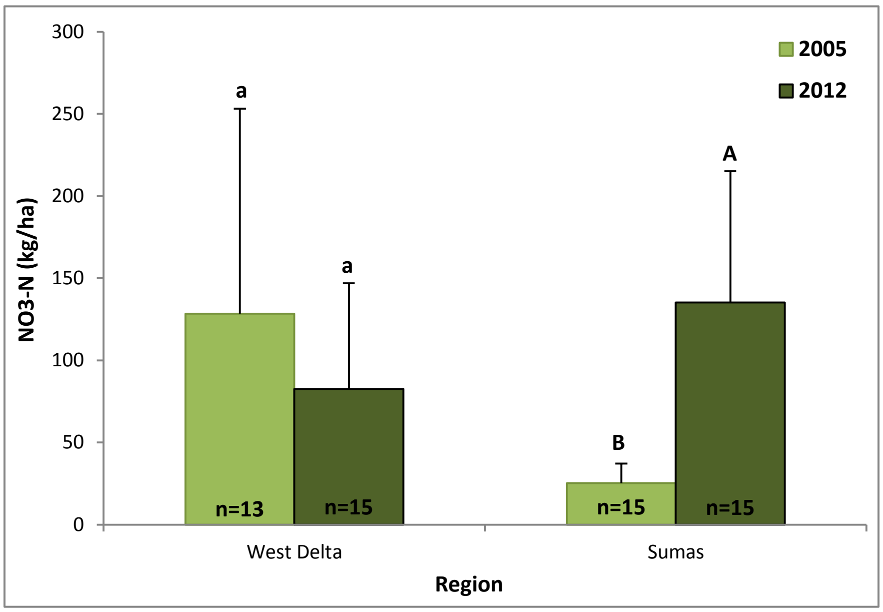

Figure 4. Mean residual soil nitrate (NO_3-N) values at 0-30 cm in vegetable fields by sample region and year. Years with the same letters for each region are not significantly different at the 5% level. Black bars indicate standard deviation. The number of fields is represented by 'n'.

Environmental risk

More than half of the fields sampled in 2012 were in the high to very high environmental risk class for soil NO_3-N (> 100 kg NO_3-N/ha at 0-60 cm). This was a 15% increase in fields in the higher risk classes as compared to 2005 results (Figure 5). Environmental risk of soil P did not change between the two study years, with approximately 10% of fields in the 'High' risk class and 90% of fields in the 'Very High' risk class. There were no medium or low risk class fields for soil test P.

Although this study did not assess the impact on receiving waters, any residual soil NO_3-N is assumed to be lost from leaching and denitrification over the winter[1]. The proposed risk classes are not specific to crop, region or soil type.

Vegetable nutrient management

Of the 30 vegetable fields sampled, 5 in Delta and 9 in Sumas received manure (or composted manure) in 2012. Based on growers records and manure conversion factors, average manure application rates were 425 kg N/ha, 133 kg P/ha, and 158 kg K/ha. Average soil test results from the manured fields exceeded those from the non-manured fields by ~85 kg NO_3-N/ha and 140 kg P/ha at 0-30 cm. More than 75% of the fields sampled applied chemical fertilizer, which had an average application rate of 70 kg N/ha, 60 kg P/ha and 125 kg K/ha.

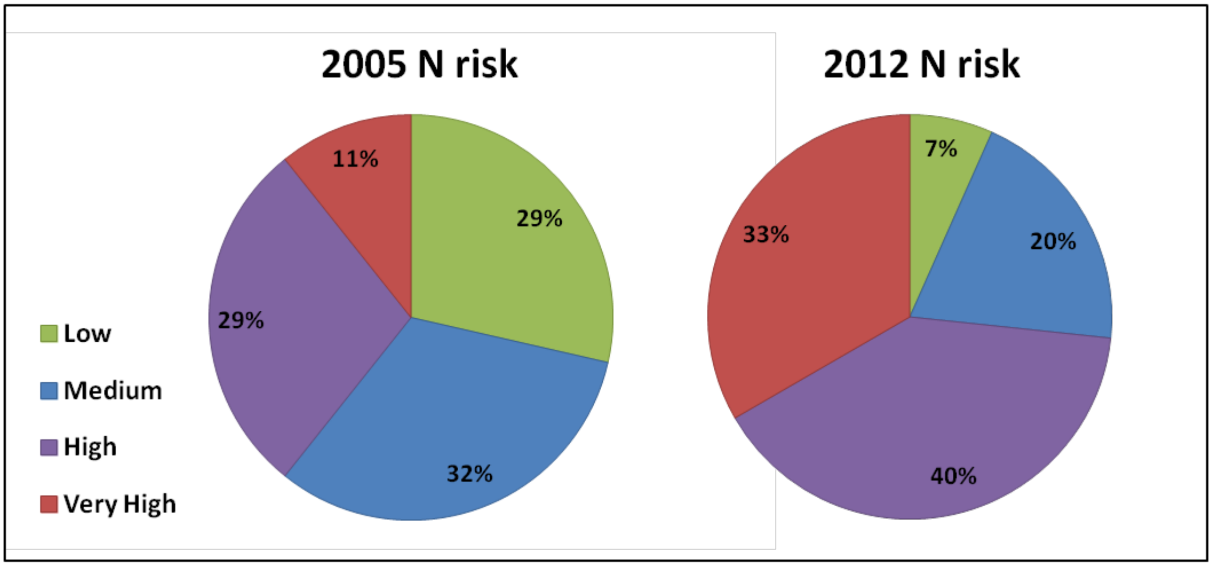

Figure 5. Distribution of vegetable fields in the environmental risk classes based on soil NO_3-N results in 2005 and 2012. Refer to 2005 FVSNS Report[1] for tables of environmental risk categories. f

Summary and Implications

The vegetable results highlight the need for improved nutrient management of both N and P, particularly with the use of manure. On average across the Valley, residual soil NO_3-N in manured fields was more than double the value in non-manured fields. The results were even higher on fields that used fresh poultry manure instead of composted poultry manure. Soil P was also substantially higher in the manured fields, which is characteristic of fields that have been continuously fertilized with poultry manure. Most of the growers applied manure every spring – a practice that builds organic N and P reserves. As the amendments are mineralized through the growing season available N and P are released, which can be in excess of crop demand and result in high residual nutrient values. In order to improve nutrient management, growers applying manure continuously need to be conscious of their application rates, the C:N:P ratio of the manure in order to estimate N and P availability, the current nutrient reserves in their soil, and of crop nutrient demand.

Nutrient management is not only a concern for manured vegetable fields; non-manured fields in the study also exceeded the environmental thresholds for N and P, and the agronomic targets for P and K. South Abbotsford fields had higher residual soil N and P results than West Delta, although the fertilizer application rates were higher in Delta. It is important to calculate nutrient inputs from both manure and fertilizer sources to avoid over-application, which has both economic and environmental consequences. Measuring soil nutrient levels in the spring can help determine whether additional amendments will be of economic value to the crop.

While it appears soil NO_3-N and P increased from 2005 to 2012 in vegetable fields, the differences in weather during the sampling periods likely had a large effect on the results. Warmer weather and optimal soil moisture conditions would have favoured a greater percentage of fields in the high risk categories in 2012 than in 2005. The high cumulative rainfall received by the end of the 2005 sampling period in Sumas also would have contributed to underestimations of residual soil NO_3-N.

Resources for Producers

The Ministry of Agriculture continues to work with growers to enhance and promote environmental farm planning and appropriate nutrient management practices. Through Growing Forward 2 funding, the provincial and federal governments continue to provide outreach and materials to B.C. farmers.

Environmental Farm Planning resources are available online.

Nutrient Management resources are available online:

References

[1] Kowalenko, C.G., Schmidt, O. and Hughes-Games, G.A. 2007. Fraser Valley soil nutrient study 2005. A survey of the nitrogen, phosphorus and potassium contents of the Lower Fraser Valley agricultural soils in relation to environmental and agronomic concerns. .

[2] Sullivan, C. 2014. 2012 Fraser Valley Soil Nutrient Study – Sampling Methodology.

[3] Poon, D. and Schmidt, O. 2010. Phosphorus considerations for nutrient management. Ministry of Agriculture.

[4] Schmidt, O. and Hughes-Games, G.A. 2012 Potassium considerations for nutrient management. Ministry of Agriculture.

[5] Ministry of Agriculture. 2010. Interpretations for soil test phosphorus and potassium – Guidelines for southern British Columbia.

Mean is the average of data in a population or group. It is calculated by adding up all of the data points from a group and dividing by the number of data points in that group.

for example – 6, 9, 11, 13, 14, 16, 20 ⟶ Mean = 89/7 = 12.7

Median is the middle point in a population or group, where half of the numbers are above and half of the numbers are below.

For example – 6, 9, 11, 13, 14, 16, 20 ⟶ Median = 13

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