Results from the 2012 Fraser Valley Soil Nutrient Study – Blueberry

Nutrient Management Factsheet

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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 blueberry fields sampled in 2012, with comparison to the 2005 blueberry findings.

Context – Weather during the study years

Weather conditions affect the amount, timing and release of plant-available forms of N and P into 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 2005 blueberry sampling period was cool and wet compared to the 2012 period (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 7	12°C avg. air temp 60-100 mm precipitation
2012	Typical	Cool and wet spring/early summer Hot and dry late summer	Aug 21 – Oct 3	16°C avg. air temp 6-8 mm precipitation

How did blueberries compare to other commodities?

Overall, blueberry fields had the highest soil N (NO_3-N & NH_4-N) values measured in the study, but were similar to other crops for residual P and K (Table 2). Sampling of the 177 fields in the Soil Study was not evenly distributed amongst the six geographic regions and six crop groups, and therefore results must be interpreted with caution. There were 30 blueberry fields sampled across the Valley in 2012: five in West Delta; five in Mt. Lehman; 14 in South Abbotsford; and six in the Sumas area of Abbotsford. All of the samples were taken from mineral soils; none from regions with organic soils.

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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. See Nutrient Management resources for info.
[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 blueberries compare across the Valley in 2012?

Residual soil NO_3-N was highly variable, but average values were high across all regions (**Figure 1**). Soil NO_3-N values at 0-30 cm ranged from 28 to 384 kg N/ha, and the median value of 119 kg N/ha was close to the overall mean in **Table 2**. Mean NO_3-N in all of the regions exceeded the threshold value for 'High to Very High' environmental risk of water contamination by N (100 kg NO_3-N /ha in 0-60 cm[1]), but blueberry fields in South Abbotsford tended to have the highest results. **Figure 1** indicates the amount of NO_3-N at 0-30 and 30-60 cm depths; the whole bar represents the total amount of NO_3-N in the soil profile (0-60 cm). Four fields in South Abbotsford had substantially higher NO_3-N results than the group: 296; 315; 332; and 384 kg N/ha. Two of these fields received manure in 2012 – an uncommon practice in blueberry production – results with the manure fields removed are shown in the blueberry figures with dashed yellow lines.

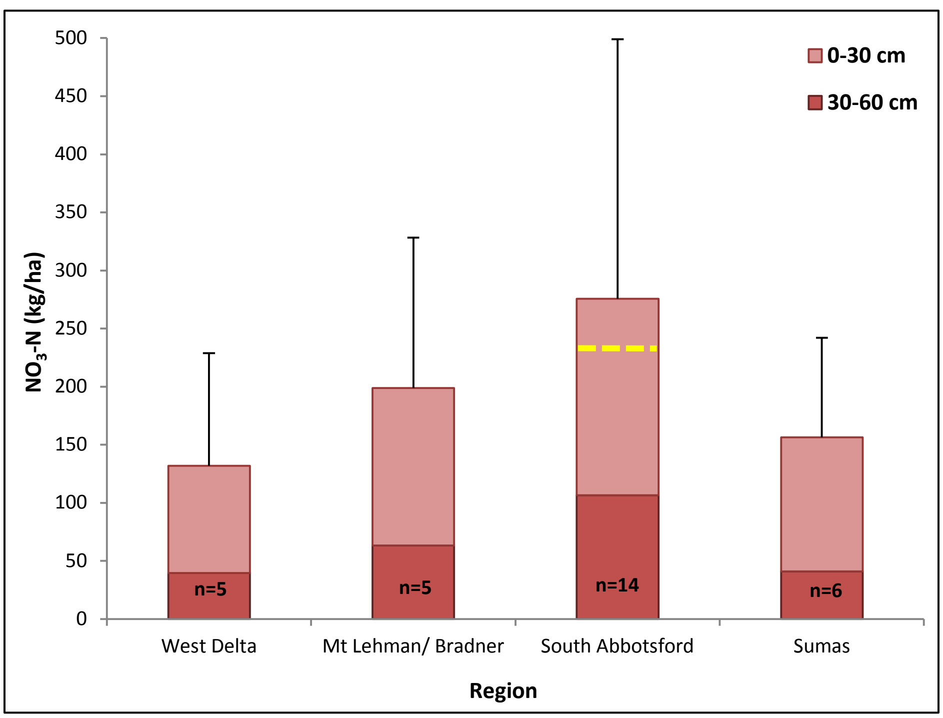

Figure 1. Mean residual soil nitrate (NO_3-N) values in blueberry fields by sample region in 2012. The yellow dashed line represents mean NO_3-N in South Abbotsford with the manured fields removed. Black bars indicate standard deviation. The number of fields sampled is represented by 'n'. There were no statistical differences among regions.

Soil P also tended to be highest in South Abbotsford (**Figure 2**), while NH_4-N and K were highest in West Delta (**Figures 3 & 4**). As a result of soils in Delta being more acidic and finer textured the higher levels of NH_4-N and K would be expected.

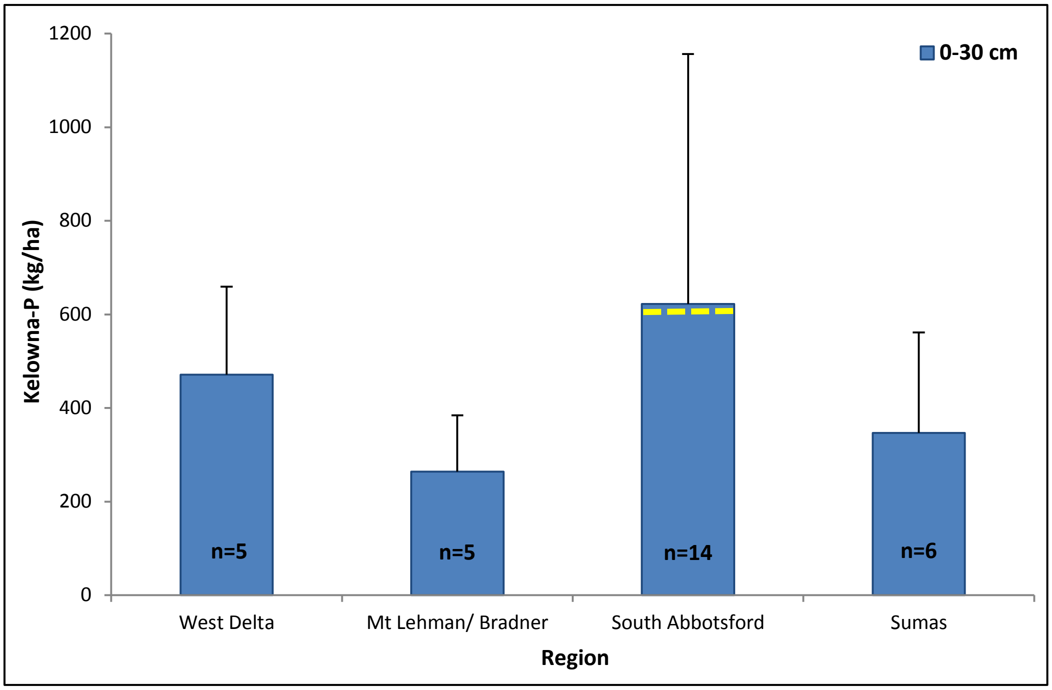

Figure 2. Mean soil test P (Kelowna equivalent) values in blueberry fields by sample region in 2012. The yellow dashed line represents mean P in South Abbotsford with the manured fields removed. Black bars indicate standard deviation. The number of fields sampled is represented by 'n'. There were no statistical differences among regions.

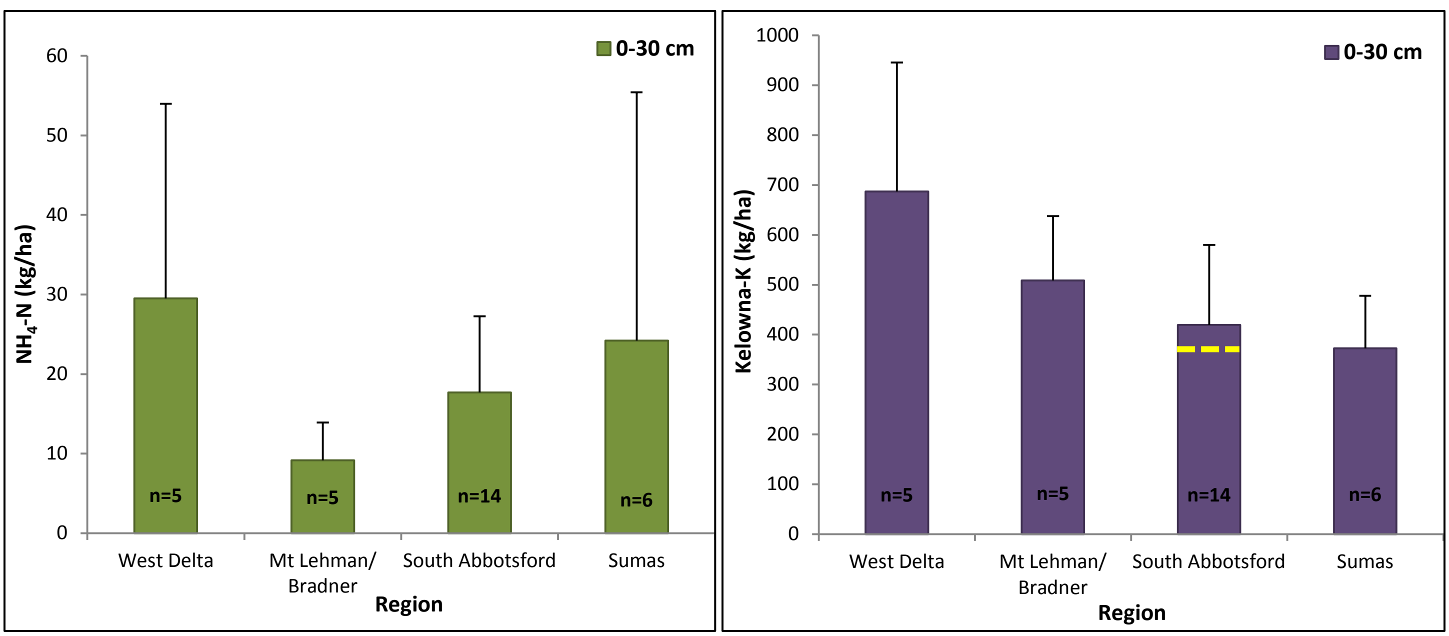

Figure 3 & 4. Mean residual soil ammonium (NH_4-N) and soil test K (Kelowna equivalent) values in blueberry fields by sample region in 2012. The manured fields did not affect the mean NH_4-N. The yellow dashed line represents mean K in South Abbotsford with the manured fields removed. Black bars indicate standard deviation. The number of fields sampled is represented by 'n'. There were no statistical differences among regions.

How did blueberry results compare with 2005 FVSNS?

In comparing study years it must be noted that many variables can influence results: field locations; crop age; nutrient management; and weather. When comparing **all fields** sampled in 2005 (16 fields) and 2012 (30 fields), the differences of soil NO_3-N and P between study years were not significant (**Table 3**). Median NO_3-N and P were higher for 2012, indicating a larger number of fields with high results compared to 2005. The N and P dynamics shifted in the study years: Delta tended to have the highest NO_3-N and P in 2005, and South Abbotsford the highest in 2012. However, the 2005 averages were skewed in Delta by one field recording extremely high N and P values, and this field was not re-sampled in 2012. Without this field in the dataset, Delta means in the two years were very similar. Similarly, the 2012 NO_3-N average in South Abbotsford was skewed by a few fields with very high values, and ignoring these fields would bring the mean very close to that recorded in 2005.

When comparing **the same** 11 fields sampled in 2005 and 2012, NO_3-N tended to be higher in 2012 and P was significantly higher in 2012 than 2005.

Overall, soil NH_4-N and K were significantly higher in 2005 than 2012 (**Table 3**). Soil K at 0-30 cm was much higher in Delta in 2005 than 2012, while the other regions were similar between the study years. The fields in Delta were likely vegetable or forage grass before conversion to blueberries, and would have a history of heavy K fertilization prior to 2005. Since K is not readily mobile in the soil it would take several years for the concentration of K to decrease with lower fertilizer rates, which may explain lower K in 2012. The cooler and wetter sampling weather in 2005 may have slowed the conversion of NH_4^+ to NO_3^- and the warm temperatures in 2012 sped up the process, which resulted in higher NH_4-N in 2005 and higher NO_3-N in 2012.

Table 3. Mean, median and maximum soil nitrate (NO_3-N), ammonium (NH_4-N), phosphorus (P) and potassium (K) values of blueberry fields from the 2005 and 2012 Fraser Valley Soil Nutrient Study. There were 16 fields sampled in 2005 and 30 fields sampled in 2012.

	NO_3-N (kg/ha to 30 cm)		NH_4-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	2005	2012
Mean	126 a[1]	140 a (126)[2]	35 a	20 b	524 a	482 a (464)	691 a	470 b (454)
Median	76	119	23	15	262	347	583	408
Maximum	549	384	114	89	2095	2175	1154	1042

[1] Means with the same letters for each nutrient are not significantly different at the 5% level.
[2] Values in brackets represent the mean values in 2012 with the two manured fields removed from the dataset.

Environmental risk

The majority of the blueberry fields sampled in 2012 were in the high to very high environmental risk classes for residual soil NO_3-N and P. The percentage of fields in the very high risk class for both NO_3-N and P increased from 2005 to 2012 (**Figure 5**), which supports the results that median values were higher in 2012 than 2005.

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.

Blueberry nutrient management

Fertilizer use on blueberries in 2012 ranged from 45 to 185 kg N/ha, 0 to 75 kg P/ha, and 0 to 143 kg K/ha. Most growers banded granular ammonium fertilizer in early spring, May and June; only a few growers used fertigation. Based on age of blueberry crop, approximately one third of the growers applied the recommended rate of N, one third applied a low rate, and one third applied a high rate. Application rates did not correlate to residual soil N values. Soil pH was in the optimal range (4.5-5.2 at 0-30 cm) in 70% of the fields sampled; seven fields were below optimal and two fields were above. The fields that had received fresh sawdust within three years prior to soil sampling tended to have lower residual soil NO_3-N, likely due to immobilization of N.

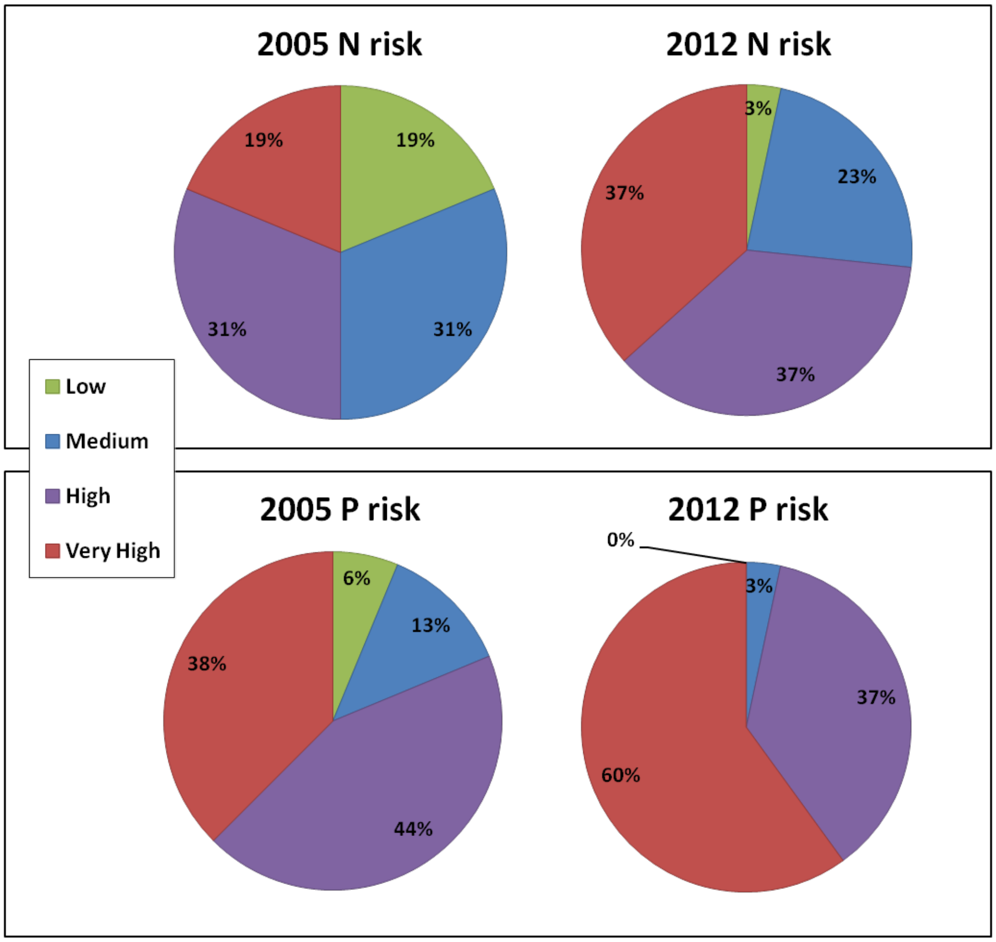

Figure 5. Distribution of blueberry fields in the environmental risk classes based on soil NO_3-N and P results in 2005 and 2012. Refer to 2005 FVSNS Report[1] for tables of environmental risk categories.

Summary and Implications

The blueberry results highlight the need for improved understanding of nutrient management in blueberry production, particularly for N. Rapid nitrate accumulation is not expected in an acidic soil environment (pH 4.5-5.2), and yet 75% of the blueberry fields sampled in the study had more than 100 kg NO_3-N/ha left in the soil at the end of the growing season. Although this value represents the soil within the berry rows and not the whole field, it indicates a very high potential for N leaching in ~50% of the blueberry field area. Nitrate leaching is a greater concern in the sandy loam soils of South Abbotsford, where fields tended to have higher NO_3-N values and are situated over the Abbotsford-Sumas aquifer.

There were few significant differences in the blueberry results when comparing sampling region or year, but NO_3-N and P results tended to be higher in South Abbotsford and environmental risk increased from 2005 to 2012. Fields that had received fresh sawdust mulch in the last three years tended to have lower residual soil NO_3-N, likely due to the mulch's ability to immobilize N. There was no relationship between the amount of fertilizer N applied and residual soil NO_3-N in 2012: low N application rates provided no guarantee of low residual soil NO_3-N. Therefore, decreases in nutrient application cannot be suggested as the sole solution to improved nutrient management in blueberries. Numerous factors are important to consider for nutrient management, such as: fertilizer blend; fertilizer application rate; timing and method; mulch management; and irrigation/precipitation patterns. Further investigation into the fate of applied fertilizer N and the conversion from ammonium to nitrate is needed.

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.

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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