Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

FOOD SAFETY ACTION PLAN

REPORT

2010-2011
TARGETED SURVEYS - CHEMISTRY
TS-CHEM-10/11

Pesticides in Intra-Provincially Traded Fresh Vegetables

RDIMS 3381119
Data Tables 3381103, 3381113

Special Surveys
Chemical Evaluation
Food Safety Division
Canadian Food Inspection Agency
1400 Merivale Road
Ottawa Ontario Canada
K1A 0Y9

Table of Contents

Executive Summary

The Food Safety Action Plan (FSAP) aims to modernize and enhance Canada's food safety system. As a part of the FSAP enhanced surveillance initiative, targeted surveys are used to test various foods for specific hazards.

The main objectives of the pesticides in intra-provincially traded fresh vegetables targeted survey were to:

- generate baseline surveillance data for pesticide residues in corn, tomatoes, potatoes, leafy greens and carrots sold intra-provincially;
- enable comparison of pesticide residue levels in leafy greens and tomatoes with results of the 2009-2010 FSAP Pesticides in Fresh Fruits and Vegetables survey; and
- enable comparison of pesticide residue levels in carrots, corn, leafy greens, potatoes, and tomatoes to complementary 2010-2011 National Chemical Residue Monitoring Program (NCRMP) data.

This survey targeted fresh vegetables that are traded intra-provincially (foods sold within the province in which they are produced/grown). The 2010-2011 FSAP Pesticide survey targeted intra-provincially traded carrots, corn, leafy greens (e.g., lettuce), potatoes, and tomatoes. In total, 1024 samples of intra-provincially traded fresh vegetables (257 carrot, 130 corn, 213 leafy green, 259 potato, and 165 tomato samples) were collected in eight of the ten provinces and were analyzed for over 430 different pesticide residues.

All of the corn samples were compliant with existing Canadian maximum residue limits (MRLs) for pesticides.

For tomatoes analyzed in this survey, 99.4% were compliant with existing MRLs for pesticides. One tomato sample contained a pesticide residue which exceeded the specific MRL for tomatoes.

For the potatoes analyzed in this survey, 99.2% were compliant with existing MRLs for pesticides. Two samples of potatoes each contained a pesticide residue which exceeded the specific MRL for potatoes.

For the leafy greens analyzed in this survey, 97.7% were compliant with existing MRLs for pesticides. A total of five samples (six violative residues in total) exceeded existing MRLs. Four of these samples of leafy greens contained a single pesticide residue each in violation of the general 0.1 parts per million (ppm) MRL (as specified in the *Food and Drug Regulations*). One sample contained two pesticide residues in violation of the general 0.1 ppm MRL.

For carrots analyzed in this survey, 97.7% were compliant with existing MRLs for pesticides. Six samples of carrots contained one pesticide residue each in violation of the general 0.1 ppm MRL.

The overall compliance rate for pesticides in this survey was 98.6%. The survey results were compared commodity by commodity to 2010-2011 data from the CFIA's National Chemical Residue Monitoring Program (NCRMP). The compliance rate for corn (100%), tomatoes (99.4%) and potatoes (99.2%) in the current survey were the same as the compliance rates for these commodities under the NCRMP. The compliance rate for leafy greens was higher in the current survey (97.7%) than under the NCRMP (91.4%). The compliance rate for carrots in the current survey (97.7%) was similar to the compliance rate for carrots under the NCRMP (98.1%).

In this survey, there were 14 violative samples (with 15 violative residues, as one sample had two violative residues). All violations were assessed and appropriate follow-up action was pursued. Exposure to the levels of pesticides detected in this survey is not expected to pose a human health concern to consumers.

1 Introduction

1.1 Food Safety Action Plan

In 2007, the Canadian government launched a five-year initiative in response to a growing number of product recalls and concerns about food safety. This initiative, called the Food and Consumer Safety Action Plan (FCSAP), aims to modernize and strengthen the food safety regulatory system. The FCSAP initiative unites multiple partners in ensuring safe food for Canadians.

The Canadian Food Inspection Agency's (CFIA) Food Safety Action Plan (FSAP) is one element of the government's broader FCSAP initiative. The goal of FSAP is to identify risks in the food supply, limit the possibility that these risks occur, improve import and domestic food controls, and identify food importers and manufacturers.

Within FSAP, there are twelve main areas of activity, one of which is risk mapping and baseline surveillance. The main objective of this area is to better identify, assess, and prioritize potential food safety hazards through risk mapping, information gathering, and testing foods from the Canadian marketplace. Targeted surveys are one tool used to test for the presence and level of a particular hazard in specific foods. Targeted surveys are largely directed towards the 70% of domestic and imported foods that are regulated solely under the *Food and Drugs Act* and *Regulations,* and are generally referred to as non-federally registered commodities.

1.2 Targeted Surveys

Targeted surveys are pilot surveys used to gather information regarding the potential occurrence of chemical residues in defined commodities. The surveys are designed to answer specific questions. Therefore, unlike monitoring activities, testing of a particular chemical hazard is targeted to commodity types and/or geographical areas.

Due to the vast number of chemical hazards and food commodity combinations, it is not possible, nor should it be necessary, to use targeted surveys to identify and quantify all chemical hazards in foods. To identify food-hazard combinations of greatest potential health risk, the CFIA uses a combination of scientific literature, media reports, and/or a risk-based model developed by the Food Safety Science Committee (FSSC), a group of federal, provincial and territorial subject matter experts in the area of food safety.

As part of CFIA's core activities, many agricultural commodities are currently being monitored under the National Chemical Residue Monitoring Program (NCRMP) for the presence of pesticide residues. This monitoring is conducted on imported and inter-provincially traded (federally registered) commodities which fall under the *Canadian Agricultural Products Act* (CAP Act). The purpose of this survey was to complement the activities of the NCRMP by targeting fresh vegetables that fall outside the purview of the CAP Act. Intra-provincially traded fresh vegetables (i.e., produce grown and sold in the same province) were targeted in this survey as they are not part of the CFIA's core

monitoring activities. The pesticide residue levels observed in carrots, corn, leafy greens, potatoes, and tomatoes in this survey were compared with pesticide residue data from the 2010-2011 NCRMP for carrots, corn, leafy greens, potatoes, and tomatoes. The pesticide residue levels observed in leafy greens and tomatoes in this survey were also compared with results from the 2009-2010 FSAP targeted survey on leafy greens and tomatoes. The other commodities were not analyzed in the previous FSAP survey.

1.3 Acts and Regulations Relating to Pesticide Residues

The *Canadian Food Inspection Agency Act* stipulates that the CFIA is responsible for enforcing restrictions on the production, sale, composition and content of foods and food products as outlined in the *Food and Drugs Act and Regulations*.

Health Canada's Pest Management Regulatory Agency (PMRA) is responsible for the registration and regulation of pesticides and the establishment of maximum residue limits (MRLs) under the *Pest Control Products Act* (PCPA). The MRL is the maximum amount of residue that is expected to remain in or on food products when a pesticide is used according to label directions. The CFIA recognizes the scientific validity of the health risk assessment carried out by Health Canada prior to establishing MRLs. Established MRLs appear on Health Canada's List of MRLs Regulated under the PCPA[1,2]. In the absence of a specific MRL for a particular commodity, pesticide residues must comply with the Canadian general MRL of 0.1 parts per million (ppm) as stated in section B.15.002(1) of the *Food and Drug Regulations*.

The analytical results from targeted survey samples were compared to applicable MRLs. Levels detected at or below these MRLs were considered in compliance with Canadian pesticide regulations for residues and did not require follow-up. All violations* were assessed and appropriate follow-up actions were pursued. Follow-up actions may include further analysis, notification of the producer or importer, follow-up inspections, additional directed sampling, and recall of products

In Canada, imported or domestically produced organic products are permitted to carry the "organic" claim when certified according to the *Organic Product Regulations (OPR)* [3]. Like conventional products, organic products are subject to the pesticide MRLs established under the PCPA. The Organic Products System Permitted Substances List referenced in the OPR stipulates which substances are permitted for use in organic products[4]. Organic products with detectable levels of pesticides not permitted for use under the OPR are referred to the appropriate CFIA program for follow-up.

Similar to the United States and the European Union, follow-up actions on organic products depend on the level of pesticides detected. Organic products with levels of pesticide in violation of the applicable MRL are subject to appropriate follow-up actions

* *Note: Since this survey was conducted and the results evaluated, Health Canada has established an MRL of 0.5 ppm for fludioxonil (September 18, 2012). The MRL replaces the previously established 0.01 ppm MRL.*
http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_decisions/emrl2012-28/index-eng.php#fn_t1be

based on the health risk. Pesticide levels which fall between 5% of the MRL and the actual MRL are considered to imply the deliberate use of a pesticide. Pesticide levels which are less than 5% of the MRL are not considered to be the result of deliberate use and may be the result of environmental contamination (for example, pesticide use in previous growing seasons, drift from pesticide-treated fields) or transfer during handling, storage or transportation with conventional products. Follow-up activities on non-compliant organic products may include further analysis, investigation of the source of the chemicals (i.e. deliberate use or other sources), and suspension/cancellation of the organic certification.

2 Survey Details

2.1 Pesticides in Fresh Vegetables

Similar to other crops, carrots, corn, leafy greens, potatoes and tomatoes are subject to various pest and disease pressures which impact their production. Pesticides are an important tool used in food production because pests such as insects, bacteria, fungi and other organisms can have devastating effects on the appearance, quantity and quality of the crop. Although pesticides play an important role in agriculture by protecting food and crops from pests, inappropriate use of pesticides may pose a health risk.

2.2 Rationale

According to Statistics Canada data from 2009, carrots, corn, leafy greens, potatoes and tomatoes make up almost two-thirds of the fresh vegetables available for consumption by Canadians[5,7]. It is estimated that Canadians consume 4.5 kg of carrots, 0.69 kg of corn, 6.05 kg of leafy greens, 4.76 kg of tomatoes, and 27.85 of kg potatoes per person per year. Each of these commodities is subject to various pest pressures and is commonly grown and sold within provincial boundaries.

While the CFIA's NCRMP program tests for residues in various commodities, its scope is limited to imported and domestic products that are sold across provincial borders. Food safety surveillance of intra-provincially traded produce generally falls under provincial jurisdiction. Provincial food safety surveillance differs from that conducted by the CFIA in the extent of their sampling and testing programmes. The present targeted survey was designed by the CFIA, in consultation with provincial partners, to generate baseline surveillance data on pesticide residues in fresh vegetables harvested and sold within a given province that are not routinely included in the NCRMP.

2.3 Sample Distribution

In this survey, a total of 1024 fresh produce samples were collected from pick-your-own farms, roadside farm stands, farmers markets, specialty and grocery stores in eight provinces (Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia) between July 2010 and March 2011. The samples included

257 carrots, 130 corn, 213 leafy greens, 259 potatoes, and 165 tomatoes. Not all commodities were sampled in all provinces where sampling occurred; the number of samples of a particular crop assigned to a targeted province was based mainly on crop production statistics.

2.4 Method Details

Samples were analyzed using multi-residue pesticide methods by laboratories under contract with the Government of Canada. The laboratories are accredited to ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories* (or its equivalent by the Standards Council of Canada (SCC)). These laboratories were required to use analytical methods that met or exceeded the requirements and limits of detection of the equivalent CFIA reference method.

Sufficient quantities of carrots, corn, leafy green, potato and tomato samples were collected to allow two different analytical methodologies to be conducted on each sample. Collectively, the two multi-residue methods can analyze for over 430 different pesticide residues with minimal overlap. Please refer to Appendix A and B for detailed lists of pesticide residues analyzed by the two multi-residue methods.

The gas chromatography-mass spectrometry (GC-MS) method used can measure up to 304 pesticide analytes (see Appendix A). This GC-MS method met or exceeded the requirements of the CFIA reference method entitled "Determination of Pesticides in Fruits and Vegetables (with Solid Phase Extraction Clean-Up and GC/MSD and HPLC Fluorescence Detection)". The GC-MS method used in this survey had limits of quantitation with an analytical range of 0.001 ppm to 0.100 ppm (depending on the analyte and the laboratory).

The liquid chromatography-mass spectrometry (LC-MS) method can measure up to 154 additional pesticides (see Appendix B, Table B1). The method is based on the CFIA reference method entitled "Determination of Pesticides in Infant Foods using Liquid Chromatography Electrospray Ionization Mass Spectrometry (LC/ESI-MS/MS)". The LC-MS method used in this survey had limits of quantitation with an analytical range of 0.00046 ppm to 0.0200 ppm (depending on the analyte and the laboratory).

The 2009-2010 FSAP targeted survey on pesticides in intra-provincially traded fresh produce[6] and 2010-2011 NCRMP samples (unpublished data) included for comparison purposes were also analyzed by both GC-MS and the LC-MS methods. The same GC-MS and LC-MS methods were used for both the 2010-2011 targeted survey and the NCRMP samples.

The 2009-2010 FSAP targeted survey used an LC-MS method which screened for the same pesticides (see Appendix B, Table B2) but differed in the detection limits. The LOD for all measured pesticides was 0.001 ppm except for aclonifen (0.005 ppm). The reporting limit for all pesticides was 0.010 ppm with the exception of the following pesticides which are at the higher reporting limit of 0.10 ppm: aclonifen, chlorthiamid, chlorbromuron, cycloxydim, pyridalyl and quizalofop.

2.5 Limitations

This survey was designed to provide a snapshot of the levels of pesticide residues in intra-provincially traded fresh vegetables (carrots, corn, leafy greens, potatoes and tomatoes) available for sale in Canada and has the potential to highlight commodities that warrant further investigation. The intent of the survey was to sample vegetables that were both grown and sold within the same province (i.e. intra-provincially traded), as these types of produce are not generally monitored by the NCRMP. Not all commodities were sampled in all provinces where sampling occurred; the number of samples of a particular crop collected from each of the eight provinces in the survey was based mainly on crop production statistics. This limited the information gathered, particularly on intra-provincially traded fresh vegetables in Prince Edward Island and Newfoundland, as well as some smaller producers in the provinces not selected for sampling of a specific vegetable. In addition, some inter-provincially traded vegetables may have been sampled and analyzed.

A number of products in the survey have been identified as organic; this designation is based on the accompanying sample information or the product label. These products may include both “certified” and “uncertified” organic products. Certified organic products are certified to the OPR by a certification body recognized by the CFIA. Uncertified organic products may be produced using organic farming practices and principles but are not certified under the OPR. The certification body was not identified for the organic products in this survey. The limited sample sizes analyzed represent a small fraction of the products available to consumers. Therefore, care must be taken when interpreting and extrapolating these results. The impacts of product shelf-life and cost of the commodity on the open market were also not examined in this survey.

3 Results and Discussion

3.1 Overview of Pesticide Results

In total, 1024 samples of intra-provincially traded fresh vegetables were sampled. This included 257 carrot, 130 corn, 213 leafy green, 259 potato, and 165 tomato samples. The overall compliance rate was 98.6%. There were 14 violative samples (with 15 violative residues, as one sample had two violative residues). All violations were assessed and appropriate follow-up actions were pursued. Exposure to these pesticides is not expected to pose a human health concern to consumers.

Table 1 presents the number of samples per product type, and the number and percentage of samples with non-detectable and detectable levels of pesticides. Samples with compliant residues refer to samples with detectable levels of pesticides that were below the applicable MRLs. The compliance rate was 97.7% for both carrots and leafy greens, 99.2% for potatoes, 99.4% for tomatoes and 100% in corn.

Table 1. Summary of pesticide results by commodity type in order of decreasing compliance rate

Commodity	Number of Samples	Number of Samples with No Detected Pesticide Residues (Percentage)	Number of Samples with Compliant Residues (Percentage)	Number of Samples with Residues in Violation (Percentage)
Corn	130	99 (76.2)	31 (23.8)	0 (0)
Tomato	165	54 (32.7)	110 (66.7)	1 (0.6)
Potato	259	22 (8.5)	235 (90.7)	2 (0.8)
Leafy Greens*	213	49 (23.0)	159 (74.7)	5 (2.3)
Carrot	257	148 (57.6)	103 (40.1)	6 (2.3)

* One sample of leafy greens contained two residues in violation; all other violative samples were associated with one violative residue each.

Table 2 presents the distribution of samples by province and illustrates the number and percentage of samples with non-detectable and detectable levels of pesticides. Not all commodities were sampled in each province, as the number of samples assigned to a province was based on crop production statistics. Potato was the only commodity sampled in all provinces (eight) within the scope of the survey. The pesticide usage in each province depends on the commodity and the pest pressures in that geographical area in a specific growing season.

Table 2. Summary of pesticide results by province in order of decreasing compliance rate

Province	Number of Samples	Number of Samples with No Detected Pesticide residues (Percentage)	Number of Samples with Compliant Residues (Percentage)	Number of Samples with Residues in Violation (Percentage)
Alberta	63	6 (9.5)	57 (90.5)	0 (0)
Manitoba	31	0 (0)	31 (100)	0 (0)
New Brunswick	82	9 (11.0)	73 (89.0)	0 (0)
Saskatchewan	23	4 (17.4)	19 (82.6)	0 (0)
Ontario	379	194 (51.2)	183 (48.3)	2 (0.5)
Quebec	358	136 (38.0)	214 (59.8)	8 (2.2)
British Columbia	30	7 (23.3)	22 (73.3)	1 (3.3)
Nova Scotia	58	16 (27.6)	39 (67.2)	3 (5.2)

A total of 81 different pesticides were detected on vegetable samples analyzed in this targeted survey. For the most part, the pesticides detected are registered for use in Canada or may be the result of environmental contamination from historical application of pesticides. Fifteen residues detected in this survey were in violation of applicable MRLs. These violations were associated with six different pesticides. Three of the violations

were for exceeding the commodity-specific MRL while the remaining twelve were associated with exceeding the general MRL. Please refer to Appendix C for a summary of pesticide residue violations in samples in this survey. Exposure to these levels of pesticides detected is not expected to pose a human health concern to consumers.

Figure 1 presents the distribution of vegetable samples by commodity type and by the number of detected pesticide residues per sample. The detected pesticide residues include both compliant and violative residues. The maximum number of pesticide residues per commodity ranged from three in corn to nine in tomatoes.

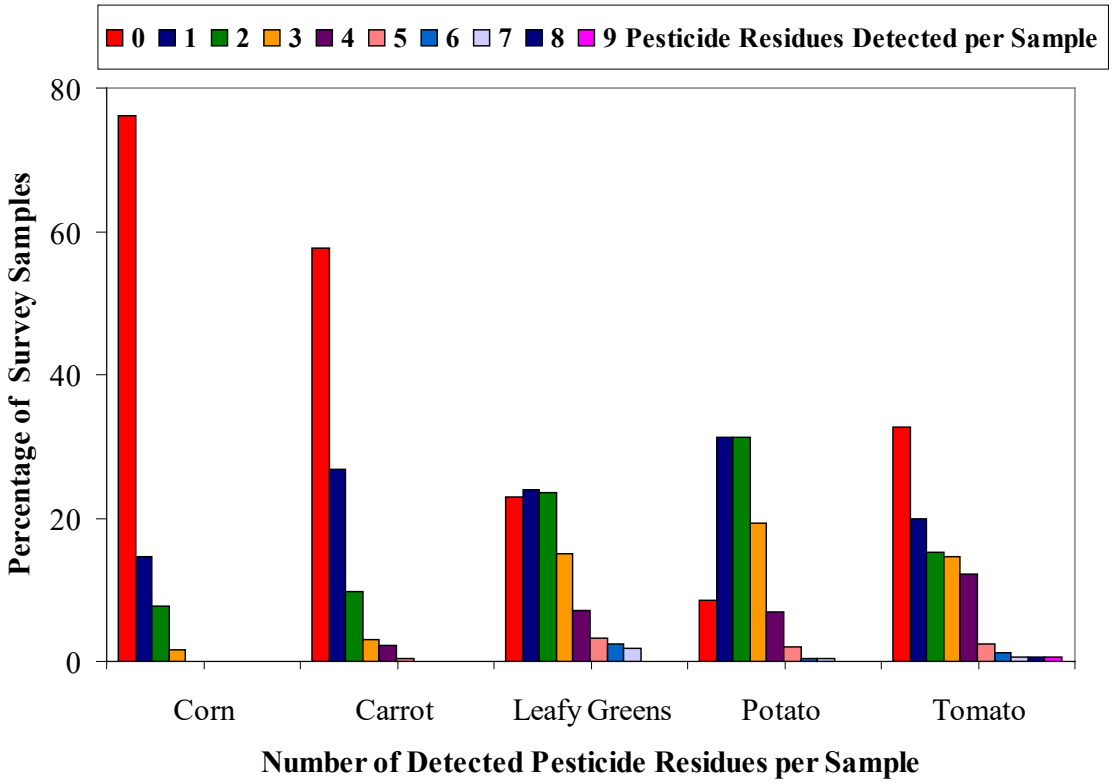

Figure 1. Distribution of vegetable samples by commodity and by number of detected pesticide residues per sample (arranged in increasing order of the maximum number of pesticide residues per sample)

Twenty-three samples in this survey were categorized as organic including two tomato, seven carrot, and 14 potato samples (sample had to be clearly labelled/recorded as being organic to be included in this category). Twelve of the organic samples contained detectable pesticide residues (one sample of carrots and eleven samples of potatoes). All samples identified in accompanying documentation as organic were compliant with applicable pesticide MRLs. However, the residue(s) detected are not permitted substances as per the Organic Production Systems Permitted Substances Lists[4], and thus may not meet the organic certification requirements[3]. These twelve results were forwarded to the appropriate program for follow-up. Follow-up activities may include further analysis,

investigation of the source of the chemicals (i.e. deliberate addition or other sources), and cancellation of the organic certification.

3.2 Pesticide Results by Product Type

The following sections present the results for pesticide residues in each of the commodity types. In these sections, the results of this targeted survey were compared to the 2010-2011 NCRMP results (unpublished data) and, where feasible, to the results of the 2009-2010 FSAP Pesticides in Intra-Provincially Traded Fresh Fruits and Vegetables targeted survey conducted by the CFIA[6].

3.2.1 Pesticides in Corn

A total of 130 fresh corn samples (including bi-colour, peaches and cream, and other types of fresh corn) were analyzed in this targeted survey. Of the total number of samples, 99 (76.2%) did not have detectable pesticide residues. No samples were collected in Nova Scotia or New Brunswick, as these provinces are not large producers of corn (based on production statistics)[7]. When the samples were broken down by province, pesticide residues were not detected in corn from Alberta (four samples) or British Columbia (three samples). Pesticide residues in the remaining provinces were detected at 8.7% in Ontario (7/80 samples) and 55.8% in Quebec (24/43 samples). None of the samples was labelled as organic.

There were 15 different pesticide residues found in corn samples. None of the residues detected in corn products were in violation of applicable MRLs, therefore the compliance rate was 100%, and no follow-up action was required.

The frequency at which specific detectable pesticide residues were found in each corn sample is illustrated in Figure 2. Approximately 94% of the samples with detectable pesticide residues contained one (19 samples) or two pesticide residues (10 samples). Six percent of the corn samples (two samples) contained three pesticide residues per sample.

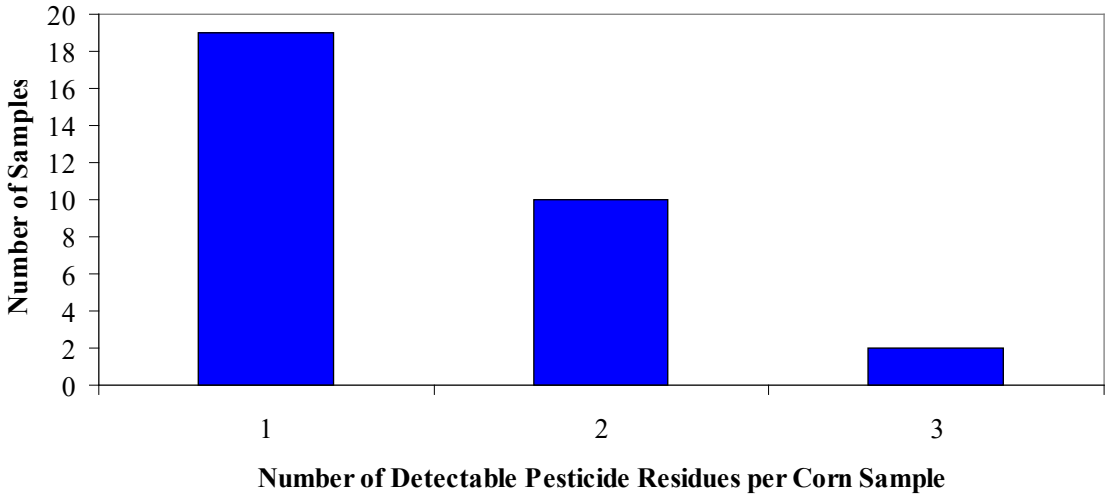

Figure 2. Distribution of corn samples by number of detected pesticide residues per sample

Corn was not among the commodities analyzed in the previous FSAP survey[6] on pesticides in intra-provincially traded fresh produce, so comparison with the current survey results was not possible. The results of the comparison to NCRMP corn sample results are summarised in Table 3. The frequency at which specific detectable pesticide residues were found in each sample in the 2010-2011 NCRMP corn samples is similar to that of the current targeted survey (see Table 3). NCRMP corn samples also had approximately the same percentage of detected pesticide residues as the corn samples in the current survey. The maximum number of pesticide residues per corn sample was three in the current FSAP survey and two in the NCRMP. The compliance rate for corn was 100% for both the targeted survey and the NCRMP, as all detected pesticide residues were below applicable MRLs.

Table 3. Comparison of 2010-11 FSAP targeted survey and 2010-2011 NCRMP corn sample results

Study	Number of Samples	Number of Samples with No Detected Pesticide Residues (Percentage)	Number of Samples with Compliant Residues (Percentage)	Number of Samples with Residues in Violation (Percentage)	Maximum Number of Pesticide Residues per Sample	Number of Samples with One or Two Detected Pesticide Residues per Sample (Percentage)
Current FSAP Survey	130	99 (76.2)	31 (23.8)	0 (0.0)	3	29 (94)
2010-2011 NCRMP	57	42 (73.7)	15 (35.7)	0 (0.0)	2	15 (100)

3.2.2 Pesticides in Tomatoes

A total of 165 tomato samples (including cocktail, grape, rainbow, plum, cherry, roma, yellow, field, and vine tomatoes) were analyzed in this targeted survey. Of the total number of samples, 54 (32.7%) of the samples did not have detectable pesticide residues. All tomatoes were sampled in Ontario, as production statistics indicate that Ontario is the major domestic producer of tomatoes[7]. Two of the 165 tomato samples collected were labelled as organic and neither of these organic samples contained detectable pesticide residues.

Twenty-five distinct pesticide residues were found in tomato samples. Only one tomato sample was in violation of an established MRL (fludioxonil in/on tomatoes* - see Appendix C for more details). Overall, the compliance rate in tomatoes was 99.4%. The single pesticide violation was evaluated and appropriate follow-up action was pursued.

The frequency at which specific detectable pesticide residues were found on each sample is illustrated in Figure 3. Fifty-two percent of samples with detectable pesticide residues contained one (33 samples) or two pesticide residues (25 samples). The remaining 48% of samples with detectable pesticide residues contained from three to a maximum of nine pesticide residues per sample. Only one sample contained nine pesticide residues.

---

* *Note: Since this survey was conducted and the results evaluated, Health Canada has established an MRL of 0.5 ppm for fludioxonil (September 18, 2012). The MRL replaces the previously established 0.01 ppm MRL. All levels of fludioxonil detected in tomato samples in this survey would not be considered violations if assessed under this new MRL.*
http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_decisions/emrl2012-28/index-eng.php#fn_t1be.

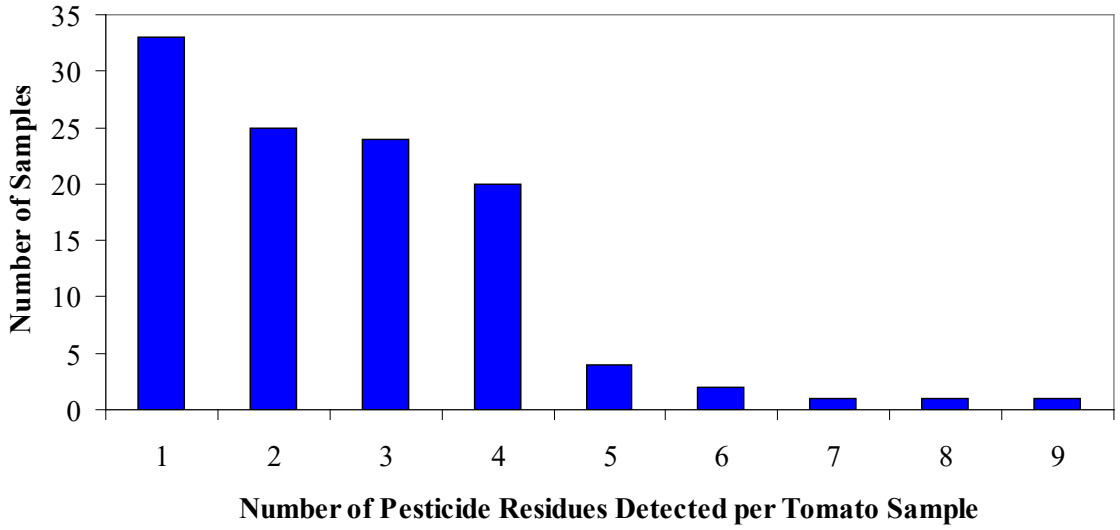

Figure 3. Distribution of tomato samples by number of detected pesticide residues per sample

Tomatoes were analyzed in the previous (2009-10) FSAP survey[6] on pesticides in intra-provincially traded fresh produce, so a comparison to both these results and the 2010-2011 NCRMP results was possible (see Table 4). The percentage of samples with pesticide residues detected was lower in the previous FSAP survey (23.3%) than in both the current targeted survey (67.3%) and the NCRMP (80.3%) tomato samples. The lower detection rate in the previous targeted survey may be related to the reporting limit being higher for pesticides analyzed by the LC-MS method in 2009-2010. The difference in pesticide detection rates may also be related to distinct pest pressures in various growing seasons or locations/provinces. The current pesticide survey examined tomatoes grown in Ontario only while the previous targeted survey reported tomato samples grown and sold within Ontario, Quebec, Alberta, BC, and the NCRMP data includes tomato samples grown domestically and traded between provinces, or imported from other countries. The maximum number of pesticide residues detected per sample was 9 in the current FSAP survey, 6 in the previous FSAP survey and 11 in the NCRMP. The compliance rates were 99.8% (previous FSAP survey), 99.4% (current FSAP survey) and 98.4% (NCRMP).

Table 4. Comparison of 2010-11 FSAP targeted survey, 2009-2010 FSAP targeted survey, and 2010-2011 NCRMP tomato sample results

Study	Number of Samples	Number of Samples with No Detected Pesticide Residues (Percentage)	Number of Samples with Compliant Residues (Percentage)	Number of Samples with Residues in Violation (Percentage)	Maximum Number of Pesticide Residues per Sample	Number of Samples with One or Two Detected Pesticide Residues per Sample (Percentage)
Current FSAP Survey	165	54 (32.7)	110 (66.7)	1 (0.6)	9	57 (52)
Previous FSAP Survey	610	468 (76.7)	141 (23.1)	1 (0.2)	6	134 (94)
2010-2011 NCRMP	365	72 (19.7)	287 (78.7)	6 (1.6)	11	185 (63)

3.2.3 Pesticides in Potatoes

A total of 259 fresh potato samples (including white, yellow, red, small/mini, baking, and russet potatoes) were analyzed in the present targeted survey. Samples were taken in all provinces within the scope of this survey. Of the total number of samples, 22 (8.5%) did not have detectable pesticide residues. When the samples were broken down by province, Saskatchewan had the least number of samples with detectable pesticide residues at 82.6% (19/23 samples). The percentage of samples with detectable pesticide residues in the remaining provinces were 85.7% for both BC and Nova Scotia (6/7 samples and 18/21 samples respectively), 89.0% in New Brunswick (73/82 samples), 91.7% in Ontario (11/12 samples), 92.3% in Quebec (24/26 samples), 96.6% in Alberta (57/59 samples) and 100% in Manitoba (29/29 samples).

Twenty-two distinct pesticide residues were found in potato samples. Two russet potato samples (see Appendix C for more details) were in violation of an applicable MRL (azoxystrobin in potatoes); therefore the compliance rate was 99.2%. All pesticide violations in potatoes were evaluated and appropriate follow-up actions were pursued.

Fourteen potato samples were identified in accompanying documentation as organic, 11 of which contained detectable levels of one or two pesticide residues. All of these samples were compliant with applicable pesticide MRLs; however, the residue(s) detected are not substances permitted for use in organic production in Canada[4] and thus may not meet the organic certification requirements[3]. The pesticide levels detected in these products were low and are unlikely to be the result of deliberate use of a pesticide. The results were forwarded to the appropriate CFIA program for follow-up. Follow-up activities may include further analysis, investigation of the source of the chemicals (i.e.

deliberate addition or other sources), and suspension/cancellation of the organic certification.

The frequency at which specific detectable pesticide residues were found in each potato sample is illustrated in Figure 4. Approximately 68% of the samples with detectable pesticide residues contained one (81 samples) or two (81 samples) pesticide residues. The remaining 32% of samples with detectable pesticide residues contained from three to a maximum of seven residues per sample. Only one potato sample contained seven pesticide residues.

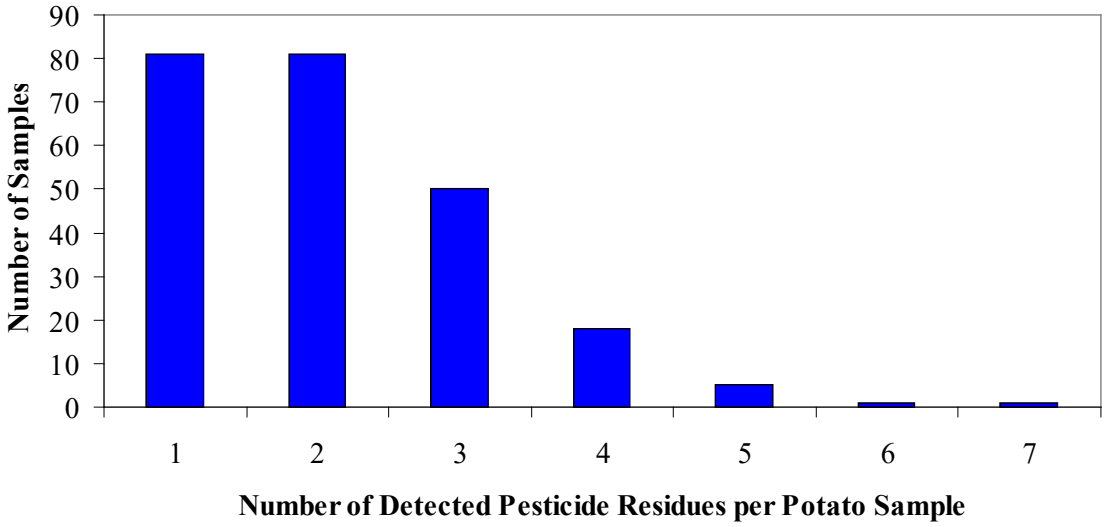

Figure 4. Distribution of potato samples by number of detected pesticide residues per sample

Potatoes were not among the commodities analyzed in the previous FSAP survey[6] on pesticides in intra-provincially traded fresh produce, so comparison with the current survey results was not possible. The distribution of the number of pesticide residues in 2010-2011 NCRMP potato samples is similar to that of the current targeted survey potato samples (see Table 5). Overall, the NCRMP potato samples had approximately 5% more detected pesticide residues than the targeted survey potato samples. The targeted survey and NCRMP samples were analyzed by the same methods with the same detection limits, so the difference in detection rates cannot be ascribed to different methods. The maximum number of pesticide residues per potato sample was seven in the current FSAP survey and nine in the NCRMP. The compliance rates were 99.2% for both the targeted survey and the NCRMP.

Table 5. Comparison of 2010-11 FSAP targeted survey and 2010-2011 NCRMP potato sample results

Study	Number of Samples	Number of Samples with No Detected Pesticide Residues (Percentage)	Number of Samples with Compliant Residues (Percentage)	Number of Samples with Residues in Violation (Percentage)	Maximum Number of Pesticide Residues per Sample	Number of Samples with One or Two Detected Pesticide Residues per Sample (Percentage)
Current FSAP Survey	259	22 (8.5)	235 (90.7)	2 (0.8)	7	162 (68)
2010-2011 NCRMP	391	32 (8.2)	356 (91.0)	3 (0.8)	9	237 (66)

3.2.4 Pesticides in Leafy Greens

A total of 213 leafy green samples (including mixed leafy vegetables, spinach, arugula, kale, leaf lettuce, and head lettuce) were analyzed. Of the total number of samples, 49 (23.0%) did not have detectable pesticide residues. No samples were collected from New Brunswick or Nova Scotia, as they are not large producers of fresh leafy greens based on production statistics[7]. When samples were broken down by province, Ontario (2/6 samples) had the lowest percentage of detectable pesticide residues at 33.3%. The percentage of samples with detectable pesticide residues in the remaining provinces were 77.6% for Quebec (149/192 samples) and 86.7% for British Columbia (14/15 samples). None of the samples were labelled as organic.

Forty-two distinct pesticide residues were found in the leafy green samples. There were five leafy green samples (i.e., leafy vegetable mix and romaine) in which the pesticide residue found exceeded the general MRL of 0.1 ppm and were considered violative (see Appendix C). One of these violative samples contained two distinct violative residues. Therefore, the compliance rate for leafy green samples was 97.7%. All pesticide violations in leafy greens were evaluated and appropriate follow-up actions were pursued.

The frequency at which specific detectable pesticide residues were found on each leafy green sample is illustrated in Figure 5. Approximately 61% of the samples with detectable pesticide residues contained one (51 samples) or two (50 samples) pesticide residues per sample. Thirty-nine percent of the samples with detectable pesticide residues contained three to a maximum of seven pesticide residues per sample. Four samples of leafy greens contained seven pesticide residues per sample.

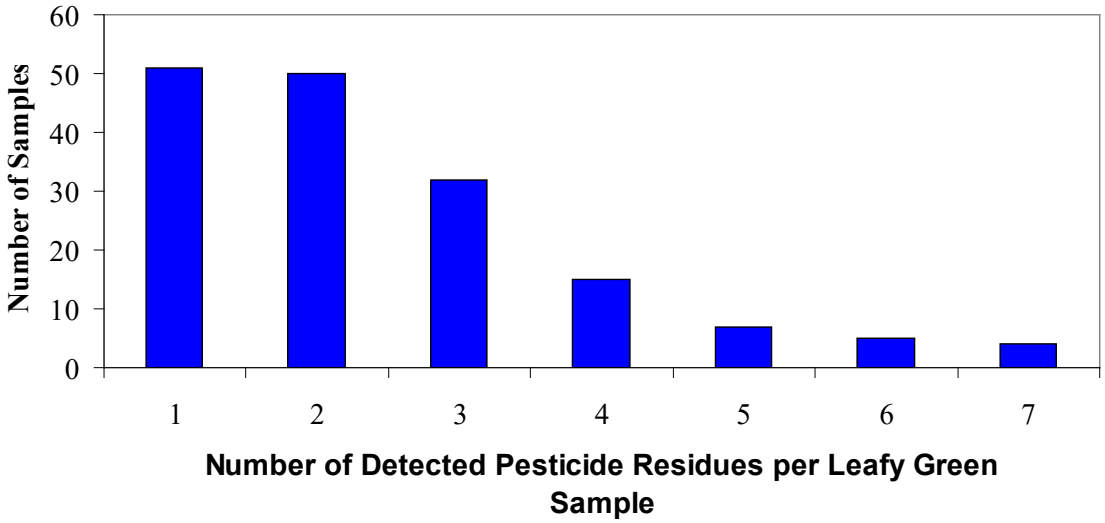

Figure 5. Distribution of leafy green samples by number of detected pesticide residues per sample

Leafy greens were analyzed in the previous FSAP survey[6] on pesticides in intra-provincially traded fresh produce, so a comparison to both these results and the 2010-2011 NCRMP results was possible (see Table 6). The positive rate for leafy greens was lower in the previous FSAP survey (28%) than in both the current FSAP survey (77%) and the NCRMP (72%) leafy green samples. The lower detection rate in the previous targeted survey may be related to the reporting limit being higher for pesticides analyzed by the LC-MS method in 2009-2010. The difference in pesticide detection rates may also be related to distinct pest pressures in different years or geographical locations. The current survey on pesticides in leafy greens included samples from Ontario, Quebec and BC. The previous targeted survey included leafy green samples grown and sold within Ontario, Quebec, Alberta and BC, while the NCRMP includes leafy green samples grown domestically and traded between provinces, or imported from other countries. The maximum number of pesticide residues per leafy green sample was 7 in the current FSAP survey, 11 in the previous FSAP survey and 14 in the NCRMP. The compliance rates were 98.7% (previous FSAP survey), 97.7% (current FSAP survey) and 91.4% (NCRMP).

Table 6. Comparison of 2010-11 FSAP targeted survey, 2009-2010 FSAP targeted survey, and 2010-2011 NCRMP leafy green sample results

Study	Number of Samples	Number of Samples with No Detected Pesticide Residues (Percentage)	Number of Samples with Compliant Residues (Percentage)	Number of Samples with Residues in Violation (Percentage)	Maximum Number of Pesticide Residues per Sample	Number of Samples with One or Two Detected Pesticide Residues per Sample (Percentage)
Current FSAP Survey	213	49 (23.0)	159 (74.7)	5 (2.3)	7	101 (61)
Previous FSAP Survey	525	377 (71.8)	141 (26.9)	7 (1.3)	11	110 (74)
2010-2011 NCRMP	397	109 (27.4)	254 (64.0)	34 (8.6)	14	150 (52)

3.2.5 Pesticides in Carrots

A total of 257 samples of fresh carrots (including baby cut and heirloom carrots) were analyzed. One hundred forty-eight (57.6%) of the samples did not have detectable pesticide residues. When the samples were evaluated by province, Quebec (97 samples) had the fewest number of samples with detectable pesticide residues at 25.8%. The percentage of samples with detectable pesticide residues in the remaining provinces were 46.6% in Ontario (54/116 samples), 64.9% in Nova Scotia (24/37 samples), 80.0% in British Columbia (4/5 samples) and 100% in Manitoba (2/2 samples).

Nineteen distinct pesticide residues were found on carrot samples. There were six carrot samples in violation of the 0.1 ppm general MRL, each with a single violative residue (see Appendix C for more details). Therefore, the compliance rate for carrot samples was 97.7%. All pesticide violations in carrots were evaluated and appropriate follow-up actions were pursued.

Seven of the 257 carrot samples were identified in accompanying documentation as organic, one of which contained a detectable level of pesticide residue. All of these samples were compliant with applicable pesticide MRLs; however, the residue(s) detected are not substances permitted for use in organic production in Canada[4] and thus may not meet the organic certification requirements[3]. The pesticide levels detected in these products were low and are unlikely to be the result of deliberate use of a pesticide. The results were forwarded to the appropriate CFIA program for follow-up. Follow-up activities may include further analysis, investigation of the source of the chemicals (i.e. deliberate addition or other sources), and suspension/cancellation of the organic certification.

The frequency at which specific detectable pesticide residues were found in each sample is illustrated in Figure 6. Eighty-six percent of carrot samples with detectable pesticide residues contained one or two pesticide residues (69 samples and 25 samples, respectively). The remaining 14% of the carrot samples contained from three to a maximum of five pesticide residues per sample. Only one carrot sample contained five pesticide residues.

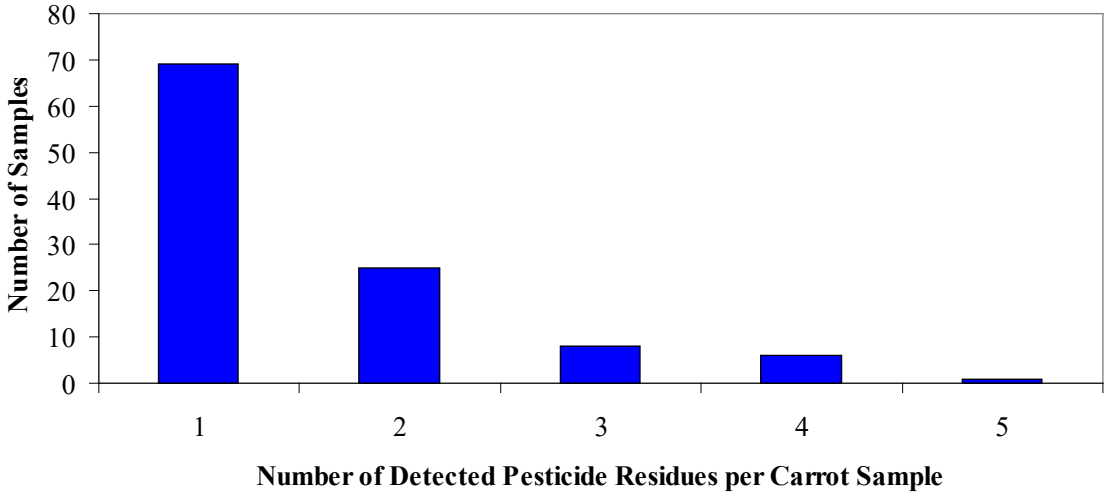

Figure 6. Distribution of carrot samples by number of detected pesticide residues per sample

Carrots were not among the commodities analyzed in the previous FSAP survey[6] on pesticides in intra-provincially traded fresh produce, so comparison to the current survey results was not possible. The frequency at which specific detectable pesticide residues were found in each of the 2010-2011 NCRMP (unpublished data) carrot samples is similar to that of the current targeted survey (Table 7). Overall, NCRMP carrot samples had approximately 17% more detected pesticide residues than the current targeted survey carrot samples. All violations (NCRMP and targeted survey) were the result of pesticide residues exceeding the 0.1 ppm general MRL. The maximum number of pesticide residues per carrot sample was five in the current FSAP survey and seven in the NCRMP.

The compliance rates for carrot samples were 97.7% and 98.1% for the targeted survey and the NCRMP, respectively.

Table 7. Comparison of 2010-11 FSAP targeted survey and 2010-2011 NCRMP carrot sample results

Study	Number of Samples	Number of Samples with No Detected Pesticide Residues (Percentage)	Number of Samples with Compliant Residues (Percentage)	Number of Samples with Residues in Violation (Percentage)	Maximum Number of Pesticide Residues per Sample	Number of Samples with One or Two Detected Pesticide Residues per Sample (Percentage)
Current FSAP Survey	257	148 (57.6)	103 (40.1)	6 (2.3)	5	94 (86)
2010-2011 NCRMP	207	84 (40.6)	119 (57.5)	4 (1.9)	7	89 (72)

4 Conclusions

The 2010-2011 fresh vegetable targeted survey generated baseline data on the levels of pesticide residues in corn, tomatoes, potatoes, leafy greens, and carrots sold intra-provincially (grown and sold in the same province). Some inter-provincially traded produce may have been sampled and analyzed. Carrots, corn, leafy greens, potatoes, and tomatoes were purchased at pick-your-own farms, roadside farm stands, farmers markets, specialty and grocery stores. Detectable pesticide residues were found in all sampled commodities.

All corn samples were compliant with existing MRLs. The commodity with the highest percentage of samples containing detectable pesticide residues was potatoes (92%), followed by leafy greens (77%), tomatoes (67%), carrots (42%) and corn (24%). The samples with the highest number of pesticide residues were a tomato (nine residues), potato (seven residues) and leafy green (seven residues) sample. Of the 1024 samples analyzed, 14 samples were in violation of applicable MRLs, with a total of 15 violative residues. Six violative residues were found in the carrot samples, six in leafy green samples, two in potato samples, and one in a tomato sample*. The compliance rate for

* *Note: Since this survey was conducted and the results evaluated, Health Canada has established an MRL of 0.5 ppm for fludioxonil (September 18, 2012). The MRL replaces the previously established 0.01 ppm MRL. All levels of fludioxonil detected in tomato samples in this survey would not be considered violations if assessed under this new MRL.*
http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_decisions/emrl2012-28/index-eng.php#fn_t1be.

pesticides in all samples analyzed in the survey was 98.6%. All pesticide violations were evaluated and appropriate follow-up actions were pursued.

A total of 23 samples identified in accompanying documentation as organic were analyzed in this survey and included two tomato, seven carrot, and 14 potato samples. Twelve of the organic samples contained detectable pesticide residues of pesticides (one sample of carrots and eleven samples of potatoes). All of these samples were compliant with applicable pesticide MRLs; however, the residue(s) detected are not substances permitted for use in organic production in Canada[4] and thus may not meet the organic certification requirements[3]. The pesticide levels detected in these products were low and are unlikely to be the result of deliberate use of a pesticide. The results were forwarded to the appropriate CFIA program for follow-up. Follow-up activities may include further analysis, investigation of the source of the chemicals (i.e. deliberate addition or other sources), and suspension/cancellation of the organic certification.

Data collected in this targeted survey on intra-provincially traded corn, tomatoes, potatoes, leafy greens, and carrots were compared to relevant 2009-2010 FSAP Pesticides in Fresh Fruits and Vegetables survey and/or 2010-2011 NCRMP data. NCRMP data included domestically produced (and inter-provincially traded) and imported commodities. The compliance rates, number and type of pesticide residues found in fresh vegetables sampled within provincial boundaries in this survey are comparable to results obtained in the previous FSAP survey and in the NCRMP.

5 References

[1] Health Canada. *List of Maximum Residue Limits Regulated Under the Pest Control Products Act* [online]. Modified May 2011. Accessed August 30, 2012. http://hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/food-nourriture/mrl-lmr-eng.php

[2] Health Canada. *Established Maximum Residue Limit* [online]. Modified August 2012. Accessed August 30, 2012. http://hc-sc.gc.ca/cps-spc/pubs/pest/_decisions/index-eng.php#mrl-lmr

[3] Department of Justice Canada. *Organic Products Regulations, 2009* [online]. Modified October 2012. Accessed October 16, 2012. http://laws-lois.justice.gc.ca/eng/regulations/SOR-2009-176/index.html

[4] Public Works and Government Services Canada. *Permitted Substances Lists* [online]. Reprinted August 2011. Accessed October 16, 2012. http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/programme-program/normes-standards/internet/bio-org/permises-permitted-eng.html

[5] Statistics Canada. *Food available by major groups in Canada* [online]. 2012. Accessed October 12, 2012, http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0020019&tabMode=dataTable&srchLan=-1&p1=-1&p2=9.

[6] Canadian Food Inspection Agency. Food Safety Action Plan Report. 2009-2010. *Pesticide Residues in Fresh Fruit and Vegetables* [online]. Modified May 2012. Accessed August 30, 2012. http://www.inspection.gc.ca/english/fssa/microchem/resid/2009-2010/frefrae.shtml

[7] Statistics Canada. *Fruit and Vegetable Production* [online]. June 2010. Accessed July 27, 2012. http://www.statcan.gc.ca/pub/22-003-x/2010001/tablesectlist-listetableauxsect-eng.htm

6 Appendix A

Combined list of analytes (304) targeted by the GC-MS multi-residue pesticide methods used by the laboratories in this survey

2-phenylphenol (ortho-phenylphenol)	Cyfluthrin (I,II,III,IV)	Fludioxonil	Pebulate
3-OH Carbofuran	Cyhalothrin-lambda	Flumetralin	Penconazole
Acephate	Cypermethrin	Fluorochloridone	Pendimethalin
Acibenzolar-s-methyl	Cyprazine	Fluorodifen	Pentachloroaniline
Alachlor	Cyproconazole	Flusilazole	Permethrin (Total)
Aldicarb	Cyprodinil	Fluvalinate	Permethrin cis
Aldicarb Sulfone	Cyromazine	Folpet	Permethrin trans
Aldicarb sulfoxide	Dacthal (chlorthal-dimethyl)	Fonofos	Phenthoate
Aldrin	delta-HCH (delta-lindane)	Heptachlor	Phorate
Allidochlor	Deltamethrin	Heptachlor epoxide endo	Phorate sulfone
Ametryn	delta-trans-allethrin	Heptanophos	Phosalone
Aminocarb	Demeton-O	Hexachlorobenzene	Phosmet
Aramite	Demeton-S	Hexaconazole	Phosphamidon
Aspon	Demeton-S-methyl	Hexazinone	Piperonyl butoxide
Atrazine	Des-ethyl Atrazine	Imazalil	Pirimicarb
Azinphos-ethyl	Desmetryn	Iodofenphos	Pirimiphos-ethyl
Azinphos-methyl	Di-allate	Iprobenfos	Pirimiphos-methyl
Azoxystrobin	Dialofos	Iprodione	Prochloraz
Benalaxyl	Diazinon	Iprodione metabolite	Procymidone
Bendiocarb	Diazinon o analogue	Isazophos	**Prodiamine**
Benfluralin	Dichlobenil	Isofenphos	Profenofos
Benodanil	Dichlofluanid	**Isoprocarb**	Profluralin
Benzoylprop-ethyl	Dichloran	Isopropalin	Promecarb
BHC Alpha	Dichlormid	Isoprothiolane	Prometon
BHC beta	Dichlorvos	Kresoxim-methyl	Prometryne
Bifenox	Diclobutrazole	Leptophos	Pronamide
Bifenthrin	Diclofenthion	Lindane (gamma-BHC)	Propachlor
Biphenyl	Diclofop-methyl	Linuron	Propanil
Bromacil	Dicofol	Malaoxon	Propargite
Bromophos	Dicrotophos	Malathion	Propazine
Bromophos-ethyl	Dieldrin	Mecarbam	Propetamphos
Bromopropylate	Diethatyl-ethyl	Metalaxyl	Propham

Bufencarb	Dimethachlor	Metazachlor	Propiconazole
Bupirimate	Dimethoate	Methamidophos	Propoxur
Buprofezin	Dinitramine	Methidathion	Propyzamide
Butachlor	**Dioxacarb**	**Methiocarb**	Prothiophos
Butralin	Dioxathion	**Methiocarb sulfoxide**	Pyracarbolid
Butylate	Diphenamid	**Methomyl**	Pyrazophos
Captafol	Diphenylamine	Methoprotryne	Pyridaben
Captan	Disulfoton	Methoxychlor	Quinalphos
Captan metabolite	Disulfoton sulfone	Methyl - trithion	Quinomethionate
Carbaryl	Edifenphos	Methyl Pentachlorophenyl sulphide	Quintozene
Carbetamide	Endosulfan alpha	Metobromuron	**Schradan**
Carbofenthion	Endosulfan beta	Metolachlor	Secbumeton
Carbofuran	Endosulfan sulfate	Metribuzin	Simazine
Carbosulfan	Endrin	Mevinphos-cis	Simetryn
Carboxin	EPN	Mevinphos-trans	Sulfallate
Chlorbenside	EPTC	Mexacarbate	Sulfotep
Chlorbenzilate	Erbon	Mirex	Sulprophos
Chlorbromuron	Esfenvalerate	Monocrotophos	TCMTB
Chlorbufam	Etaconazole	Monolinuron	Tebuconazole
Chlordane cis	Ethalfluralin	Myclobutanil	Tecnazene
Chlordane trans	Ethion	Naled	Terbacil
Chlordimeform	Ethofumsate	Nitralin	Terbufos
Chlorfenson	Ethoprophos	Nitrapyrin	Terbumeton
Chlorfenvinphos (e+z)	Ethylan	Nitrofen	Terbutryne
Chlorflurenol-methyl	Etridiazole	Nitrothal-isopropyl	Terbutylazine
Chloridazon	Etrimfos	Norflurazon	Tetrachlorvinphos
Chlormephos	Fenamiphos	Nuarimol	Tetradifon
Chloroneb	Fenamiphos sulfone	o,p'-DDD (o,p'-TDE)	Tetraiodoethylene
Chloropropylate	Fenamiphos sulfoxide	o,p'-DDE	Tetramethrin
Chlorothalonil	Fenarimol	o,p'-DDT	Tetrasul
Chlorpropham	Fenbuconazole	Octhilinone	Thiobencarb
Chlorpyrifos	Fenchlorophos (Ronnel)	Omethoate	Tolclofos-methyl
Chlorpyriphos-methyl	Fenfuram	Oxadiazon	Tolyfluanid
Chlorthiamid	Fenitrothion	Oxadixyl	Triadimefon
Chlorthion	Fenpropathrin	**Oxamyl**	Triadimenol
Chlorthiophos	**Fenpropimorph**	Oxycarboxin	Tri-allate

Chlozolinate	Fenson	Oxychlordane	Triazophos
Clomazone	Fensulfothion	Oxyflurofen	Tribufos
Coumaphos	Fenthion	p,p'-DDD (p,p'-TDE)	Tricyclazole
Crotoxyphos	Fenvalerate	p,p'-DDE	Trifloxystrobin
Crufomate	Flamprop-isopropyl	p,p'-DDT	Triflumizole
Cyanazine	Flamprop-methyl	Paraoxon	Trifluralin
Cyanophos	Fluchloralin	Parathion	Vernolate
Cycloate	Flucythrinate	Parathion-methyl	Vinclozolin

Note: Pesticides highlighted in bold are detected in both the GC-MS and LC-MS analytical methods.

7 Appendix B

Table B1. Combined list of analytes (154) targeted in the LC-MS multi-residue pesticide methods used by the laboratories in this survey

3-hydroxy Carbofuran	Diniconazole	**Linuron**	Pyrifenox
Acetochlor	**Dioxacarb**	Mepanipyrim	Pyrimethanil
Aclonifen	Dipropetryn	Mephosfolan	Pyriproxyfen
Aldicarb	Diuron	Methabenzthiazuron	Quinoxyfen
Aldicarb Sulfone	Dodemorph	**Methidathion**	Quizalofop
Aldicarb sulfoxide	Emamectin	**Methiocarb**	Quizalofop-ethyl
Azaconazole	Epoxiconazole	Methiocarb sulfone	**Schradan**
Benomyl	Ethiofencarb	**Methiocarb sulfoxide**	Spinosad A
Benoxacor	Ethiofencarb sulfone	**Methomyl**	Spinosad D
Bitertanol	Ethiofencarb sulfoxide	Methoxyfenozide	Spirodiclofen
Bromuconazole	Ethirimol	Metolcarb	Spiromesifen
Butafenacil	Ethoprop	Metoxuron	Spiroxamine
Butocarboxim sulfoxide	Etofenprox	**Mexacarbate**	Sulfentrazone
Cadusafos	Etoxazole	Molinate	Tebufenozide
Carbaryl	Fenamidone	**Monocrotophos**	Tebufenpyrad
Carbendazim	Fenazaquin	Napropamide	Tebupirimfos
Carbofuran	Fenhexamid	Naptalam	Tepraloxydim
Carbosulfan	Fenoxanil	Neburon	Tetraconazole
Carfentrazone-ethyl	Fenpropidine	Ofurace	Thiabendazole
Chlorbromuron	**Fenpropimorph**	**Oxadixyl**	Thiacloprid
Chloridazon	Fenpyroximate	**Oxamyl**	Thiamethoxam
Chlorimuron-ethyl	Fentrazamide	Oxamyl oxime	Thiazopyr
Chloroxuron	Fluazifop-butyl	**Oxycarboxin**	Thiodicarb
Chlorthiamid	Flucarbazone-sodium	Paclobutrazol	Thiofanox
Chlortoluron	Flutolanil	Pencycuron	Thiofanox sulfone
Clodinafop-propargyl	Flutriafol	Penoxsulam	Thiofanox sulfoxide
Cloquintocet-mexyl	Forchlorfenuron	Picolinafen	Thiophanate methyl
Clothianidin	Formetanate	Picoxystrobin	**Tolyfluanid**
Cyanofenphos	Fosthiazate	Piperophos	Tralkoxydim
Cycloxydim	Fuberidazole	Pretilachlor	Trichlorfon
Cycluron	Furathiocarb	Primisulfuron-methyl	**Tricyclazole**

Demeton-s-methyl sulfone	Haloxyfop	**Prodiamine**	Trietazine
Demeton-s-methyl sulfoxide	Imazamethabenz-methyl	**Propoxur**	Trifloxysulfuron
Desmedipham	Imidacloprid	Pymetrozine	Triforine
Diclocymet	Indoxacarb	Pyraclostrobin	Trimethacarb
Diethofencarb	Iprovalicarb	Pyraflufen-ethyl	Zinophos
Difenoconazole	Isocarbamide	Pyridalyl	Zoxamide
Dimethametryn	**Isoprocarb**	Pyridaphenthion	
Dimethomorph	Isoxathion	Pyridate	

Note: Pesticides highlighted in bold are included in both the GC-MS and LC-MS methods.

Table B2. List of analytes (146) targeted by the LC-MS pesticide multi-residue method used by the CFIA Calgary laboratory in the 2009-10 FSAP survey

Acetochlor	Epoxiconazole	Molinate	Thiamethoxam
Aclonifen	Ethiofencarb	Napropamide	Thiazopyr
Aldicarb	Ethiofencarb sulfone	Naptalam	Thiodicarb
Aldicarb sulfone	Ethiofencarb sulfoxide	Neburon	Thiofanox
Aldicarb sulfoxide	Ethirimol	Ofurace	Thiofanox sulfone
Azaconazole	Ethoprop	**Oxamyl**	Thiofanox sulfoxide
Benomyl[b]	Etofenprox	Oxamyl-oxime	Thiophanate-methyl[b]
Benoxacor	Etoxazole	Paclobutrazol	Tralkoxydim
Bitertanol	Fenamidone	Pencycuron	Trichlorfon
Bromuconazole	Fenazaquin	Penoxsulam	Trietazine
Butafenacil	Fenhexamid	Picolinafen	Trifloxysulfuron
Butocarboxim	Fenoxanil	Picoxystrobin	Triforine
Carbaryl	Fenpropidine	Piperophos	Trimethacarb
Carbendazim	**Fenpropimorph**	Pretilachlor	Zinophos
Carbendazim d_3	Fenpyroximate	Primisulfuron-methyl	Zoxamide
Carbendazim d_4	Fentrazamide	**Prodiamine**	
Carbofuran	Fluazifop-butyl	Propoxur	
Carbofuran d_3	Flucarbazone-sodium[a]	Pymetrozine	
Carbosulfan[c]	Flutolanil	Pyraclostrobin	
Carfentrazone-ethyl	Flutriafol	Pyraflufen-ethyl	
Cadusafos	Forchlorfenuron	Pyridalyl	
Chlorimuron ethyl	Formetanate[a]	Pyridaphenthion	
Chloroxuron	Fosthiazate	Pyridate	
Chlortoluron	Fuberidazole	Pyrifenox	
Clodinafop-propargyl	Furathiocarb	Pyrimethanil	
Cloquintocet-mexyl	Haloxyfop	Pyriproxyfen	
Clothianidin	3-Hydroxycarbofuran	Quinoxyfen	
Cyanofenphos	Imazamethabenz-methyl	Quizalofop	
Cycloxydim	Imidacloprid	Quizalofop ethyl[f]	
Cycluron	Indoxacarb	**Schradan**	
Demeton-s-methyl sulfone	Iprovalicarb	Spinosad A[d]	
Demeton-s-methyl	Isocarbamide	Spinosad B[d]	

sulfoxide			
Desmedipham	**Isoprocarb**	Spirodiclofen	
Diclocymet[a]	Isoxathion	Spiromesifen	
Diethofencarb	Mepanipyrim	Spiroxamine[e]	
Difenoconazole	Mephosfolan	Sulfentrazone	
Dimethametryn	Methabenzthiazuron	Tebufenozide	
Dimethomorph	**Methiocarb**	Tebufenpyrad	
Diniconazole	Methiocarb sulfone	Tebupirimfos	
Dioxacarb	**Methiocarb sulfoxide**	Tepraloxydim	
Dipropetryn	**Methomyl**	Tetraconazole	
Diuron	Methoxyfenozide	Thiabendazole	
Dodemorph	Metolcarb	Thiabendazole	
Emamectin	Metoxuron	Thiacloprid	

Note: Pesticides highlighted in bold are detected in both the GC-MS and LC-MS analytical methods.

8 Appendix C

Summary of pesticide residue violations found in the 2010-2011 Intra-Provincially Traded Fresh Vegetables Survey

Sample Type	Province	Pesticide Residue	Detected Amount (ppm)
Red cluster tomato on vine	Ontario	Fludioxonil	0.0109**
Russet Potato	Quebec	Azoxystrobin	0.0787
Russet Potato	Quebec	Azoxystrobin	0.1009
Leafy Vegetable Mix	Quebec	Cypermethrin	0.1145
Lettuce	Quebec	Cypermethrin	0.1146
Lettuce	Quebec	Dimethomorph	0.1280
Curly Lettuce	Quebec	Dimethomorph	0.1336
Romaine Lettuce*	Ontario	Dimethomorph	0.3516
		Cypermethrin	0.5662
Carrot	Nova Scotia	Linuron	0.1800
Carrot	Nova Scotia	Linuron	0.2200
Carrot	British Columbia	Linuron	0.2700
Carrot	Nova Scotia	Linuron	0.3000
Carrot	Quebec	Chlorpyrifos	0.8550
Yellow Carrot	Quebec	Chlorpyrifos	4.9300

* This sample contained two violative residues. All other violative samples were associated with a single violative residue.

***Note: Since this survey was conducted and the results evaluated, Health Canada has established an MRL of 0.5 ppm for fludioxonil (September 18, 2012). The MRL replaces the previously established 0.01 ppm MRL. All levels of fludioxonil detected in tomato samples in this survey would not be considered violations if assessed under this new MRL.* http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_decisions/emrl2012-28/index-eng.php#fn_t1be.