Ministry for Primary Industries
Manatū Ahu Matua

Pesticide Residues in Plant Products 2013-2014

A survey under the Food Residues Surveillance Programme (FRSP)

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1 EXECUTIVE SUMMARY

Over the last ten years, Ministry for Primary Industries (MPI) has conducted surveys to monitor levels of agricultural compound residues (known as ag-chem residues for the rest of the report) in plant products. This monitoring programme aims to verify that levels of ag-chems in food for sale in New Zealand comply with the New Zealand Maximum Residue Levels (MRLs) and that ag-chems are being used by growers according to good agricultural practice (GAP). MRLs are set well below levels which are known to have any adverse health effects and have substantial safety margins built into them. Information on how MRLs are set and the factors that MPI considers when setting a new MRL or changing an existing MRL can be found here (http://www.foodsafety.govt.nz/elibrary/industry/2010-11-food-tech-mrl-setting.htm).

Between 2013 and 2014, MPI collected 388 samples of locally grown fresh fruit and vegetables and 56 samples of imported produce. The main outcomes of this survey are summarised in the tables below.

Table 1. Compliance* rate of the 2013-14 FRSP survey test results

Total Number. of test results	Percentage of compliant test results (%)	Number of samples tested	Percentage of compliant samples (%)
194, 541	99.998	444	99.1

**Compliance of samples were determined using the New Zealand MRL standards 2013 which would be applicable to the samples collected for the 2013-2014 plant products survey.*

Table 2 Samples with residues exceeding the applicable MRLs

Ag-chem residues detected	Amount (mg/kg)	Crop	Country of origin	Applicable MRLs (mg/kg)
Bifenthrin	0.14	Grapes	Chile	0.1
Fluazinam	0.03	Potatoes	New Zealand	0.02
Imidacloprid	0.03	Potatoes	New Zealand	0.02
Metalaxyl	0.06	Tomatoes	New Zealand	0.05
Methamidophos	0.71	Tomatoes	New Zealand	0.1

These five samples were further assessed for the dietary risk to consumers posed by the residues found exceeding the MRLs. Exposure assessments of these residues were calculated for adults and children separately. The calculated exposure values were evaluated and indicated negligible risks to health from these five residue levels above the MRLs. The analysis of the exposure values and consumption factors are found in Section 4.2 of the report.

This survey provided a ‘snapshot’ of New Zealand horticultural industry compliance with GAP in the use of ag-chems. The overall outcome indicates that GAP is closely followed by New Zealand growers and that plant products sold in New Zealand including imported produce complies with New Zealand MRL requirements. Suppliers of those samples were from four domestic growers and one importer. They were informed of the non-compliances and reminded of the importance of adhering to GAP and the New Zealand MRL standard. MPI will continue to monitor levels of ag-chem residues in fruit and vegetable in future surveys.

2 DEFINITIONS AND GLOSSARY

ARfD	Acute Reference Dose
ACVM	Agricultural Compounds and Veterinary Medicines
ADI	Average Daily Intake
Ag-chem	Agricultural chemical active ingredient
Agricultural compound residues	A specified substance in food, horticultural produce, or animal feed resulting from the use of an agricultural compound (from known, unknown or unavoidable sources).
bw	Body weight
CODEX	Codex Alimentarius. A set of international food standards published by the joint FAO/WHO Codex Alimentarius Commission (CAC). These standards include maximum residue limits for pesticides.
Default MRL	A legal limit of 0.1 mg/kg that is specified in 6(2) of the New Zealand (Maximum Residue Limits of agricultural compounds) Food Standards as applying to all ag-chem/food combinations for which no specific MRL has been established. This limit is equivalent to 1 part of an agricultural compound in ten million parts of food.
EPA	Environmental Protection Authority
EFSA	European Food Safety Authority
FRSP	Food Residues Surveillance Programme
GCMS	Gas Chromatography Mass Spectrometry
GAP	Good Agricultural Practice (GAP) is the officially recommended or nationally authorised use of pesticides under actual conditions necessary for effective and reliable pest control. It encompasses a range of levels of pesticide applications up to the highest authorised use, applied in a manner which leaves a residue which is the smallest amount practicable. (FAO Document The International Code of Conduct on Pesticide Management 2014)

LCMS	Liquid Chromatography Mass Spectrometry
LOR	Limit of Reporting is the minimum concentration of an analyte in a (combined) sample that can be reported with a reasonable degree of accuracy and precision.
mg/kg	Milligrams per kilogram; can also be expressed as parts per million (ppm).
MRL	Maximum Residue Limit, this is the maximum legal limit of a residue permitted in or on a food for sale in New Zealand as defined in the New Zealand (Maximum Residue Limits of Agricultural Compounds) Food Standards 2013.
MPI	Ministry for Primary Industries (formerly MAF and NZFSA)
PDE_{food}	Potential Daily Exposure
WHO	World Health Organisation
WHP	Withholding period, this is the recommended minimum period which should elapse between the last administration or application of an agricultural chemical product, including treated feed, and the slaughter, collection or harvesting for human consumption or the use of animal commodity.

3 INTRODUCTION

3.1 OBJECTIVES AND BACKGROUND OF FRSP

The objectives for 2013-2014 FRSP were to determine:

1. GAP was followed in the applications of ag-chems to New Zealand plant products.
2. Whether plant products available for sale in New Zealand comply with the requirements of the New Zealand MRL Food Standard.

Ministry for Primary Industries (MPI) provides food assurance to New Zealand consumers and international trading partners through its various food monitoring programmes. Since 2003, MPI has been running the FRSP that monitors residues and contaminants in food available in New Zealand. The FRSP is designed to:

- monitor compliance in relation to new and existing food regulatory measures;
- identify issues of potential importance to public health and safety;
- monitor long term trends in the levels of residues and contaminants in food.

The levels of ag-chem residues detected in survey samples were evaluated against the New Zealand MRL Standard for GAP compliance. The New Zealand MRL Food Standard allows for imported food to comply with a Codex MRL, and where no Codex MRL exists, the New Zealand MRL applies. MRLs are set well below levels which are known to have any adverse health effects with substantial safety margins built into them. Information on how MRLs are set and the factors that MPI considers when setting a new MRL or changing an existing MRL can be found here (http://www.foodsmart.govt.New Zealand/whats-in-our-food/chemicals-nutrients-additives-toxins/agricultural-production/mrls/). For foods sold domestically, or imported food that have no specific MRL under the New Zealand MRL Standard, the default MRL will apply. The default MRL is 0.1 mg/kg. More information on the default MRL can be found here (http://www.foodsafety.govt.New Zealand/elibrary/industry/register-list-mrl-agricultural-compounds.htm).

The FRSP survey is not designed to target the compliance status of individual growers, but provide a 'snap-shot' of GAP compliance by growers and MRL compliance by importers over the 2013-2014 period. Registrations of new ag-chems, phasing out existing ag-chems, changes to current MRLs, and international intelligence are all factors that contributed to the design of the survey.

Residue levels in samples that exceed the New Zealand MRLs are referred to as non-compliances. Growers or importers are directly notified when this occurs.

3.2 DESIGN AND SCOPE OF THE 2013-2014 FRSP SURVEY

The recently approved ag-chems were provided by the Agricultural Compounds and Veterinary Medicines (ACVM) group of MPI that administers the registration and approval of new ag-chems used in New Zealand under the ACVM Act. In relation to objective 1 of this survey (stated in 3.1), 11 ag-chems approved for use in New Zealand during the previous period 2011/12 were targeted. The aim was to assess if these recently approved ag-chems were applied correctly to crops by New Zealand growers. The targeted ag-chems approved for different crops are presented in Table 3.

Table 3 (Group 1) Ag-chems approved in 2011-2012 for agricultural crops

No.	Recently approved ag-chem	Label Claim
1	Acibenzolar-S-methyl	Kiwi fruit
2	Acrinathrin	Potatoes, Tomatoes
3	Ametoctradin	Potatoes
4	Etoxazole	Avocados
5	Fenbuconazole	Apples
6	Fluopyram	Onions
7	Penthiopyrad	Apples,
8	Proquinazid	Apples, Grapes, Melons
9	Saflufenacil	Apples, Maize
10	Triticonazole	Tomatoes
11	Uniconazole-P	Avocados

In relation to objectives 1 and 2, 430 ag-chems previously analysed in the 2011/12 FRSP survey are also included in this survey. A list of Group 1 and 2 ag-chems can be found in Appendix 6.1.

The scope of the survey included New Zealand plant products (known as domestic produce from herein) and imported produce. Nine agricultural crops were targeted from the label claims and a total of 444 samples were collected, with approximately 13% (56/444) of them being imported samples. The exporting countries were Australia, Chile, Italy, Mexico, Tonga and United States of America (listed alphabetically). The quantity of domestic and imported samples for each produce group is provided in Section 4: Results. The nature of crop production, such as year to year weather variation, seasonal maturation, and crop yields, presented challenges to the sample collection process. Some of these factors influenced the availability of domestic crops, therefore, affecting the importation of certain crops such as maize and tomatoes. The FRSP survey samplers were unable to collect the planned sample numbers for some crops. (For further details of the targeted, collected and analysed figures, please refer to the Appendix 6.2).

Sample collection was initiated in June 2013 and completed by July 2014. Chemical analysis and results consolidation were completed in November 2014. These nine agricultural crops, harvested and imported in 2013-2014, were collected from various sampling sites.

3.3 METHODOLOGY OF 2013-2014 FRSP SURVEY

3.3.1 Sampling

The sampling sites included supermarkets, independent retailers (specialty grocers), pack houses, wholesalers/importers, milling plants for maize, horticultural growers and farms. The sampling protocols followed international (FAO) guidelines with respect to the minimum sample sizes. For example, one apple sample was made up of ten or more apples from a randomly selected batch and weighed (at least) 1 kg in total. Details of how units and minimum weights are defined for the other eight agricultural crops are included in Appendix 6.3.

3.3.2 Chemical Analysis

The protocol of how the samples were prepared for residues testing, was adapted from Codex Guideline CAC/GL 41 (English version). The individual samples were prepared and extracted for analysis using both the Liquid Chromatography-Mass spectrometry (LC-MS/MS) and Gas Chromatography-Mass Spectrometry (GCMS) instruments. Residues detected above the limit of reporting (LOR) were quantified and reported in units of mg/kg.

3.3.3 Residues Compliance

The detected residues were evaluated against the established New Zealand or Codex MRLs. All results from imported produce were evaluated against the higher of the New Zealand or Codex MRLs. In the case of Australian samples, the higher of the Australia or New Zealand MRLs was used in evaluating the residues reported.

3.3.4 Dietary Risk Assessment of Non-compliances

A dietary exposure assessment is the process of estimating how much of a food chemical a population, or population sub group, consumes (FSANZ, 2014). Dietary exposure to (or intake of) food chemicals is estimated by combining food consumption data with health based guidance values. In this report, only survey samples that exceeded the MRLs were estimated for dietary risk assessments. The dietary risk assessments of this survey were conducted in accordance with WHO guidelines. These dietary risk assessments were further determined for chronic (long-term/ lifetime) exposure risk of the average consumer and acute (short term) exposure risk of the high volume consumers of a particular food.

Food consumption data

Two New Zealand population sub groups were identified for these risk assessments: adults and children. The food consumption values (in g/kg of body weight (bw)/day) have been derived for the adults from the 2008 New Zealand Adult Nutrition Survey and, for the children from the 2002 New Zealand Child Nutrition Survey. To determine the chronic exposure, the mean survey respondent intake values of the surveys were used. For the acute exposure, 97.5th percentile consumption values were used, representing a potential high consumer of that food.

Health based guidance values

The established health based guidance values for these risk assessments were derived from the Environmental Protection Authority (EPA), the European Food Safety Authority (EFSA) and the World Health Organisation (WHO). Their health based guidance values used to assess the five non-compliant residues found in this survey were:

1. Potential Dietary Exposure (PDE_{food}) from EPA, or in their absence,
2. Acceptable Daily Intake (ADI) from EFSA or WHO
3. Acute Reference Dose (ARfD)

4 RESULTS

4.1 SUMMARY OF RESIDUES DETECTED

A total of 194,541 residue results were obtained from screening 444 samples for over 400 (of Group 1 and 2) ag-chems. Three Group 1 residues (etoxazole, fluopyram and proquinazid) were detected in six samples but none of the detections were over the MRLs. Sixty-nine Group 2 residues were detected in 178 samples. Of the 178 samples, five samples had residues over the applicable MRLs (Table 4). The non-compliant samples were from grapes, potatoes and tomatoes.

Table 4 Samples with residues exceeding the applicable MRLs

Ag-chem residues detected	Amount (mg/kg)	Crop	Country of origin	Applicable MRL (mg/kg)
Bifenthrin	0.14	Grapes	Chile	0.1
Fluazinam	0.03	Potatoes	New Zealand	0.02
Imidacloprid	0.03	Potatoes	New Zealand	0.02
Metalaxyl	0.06	Tomatoes	New Zealand	0.05
Methamidophos	0.71	Tomatoes	New Zealand	0.1

The non-compliant samples were traced back to individual domestic growers and importers. They were sent notification letters emphasising the importance of GAP and the appropriate actions to be initiated by them to prevent future occurrence.

For the tomato sample that breached the MRL for methamidophos, the grower was informed of this result and a formal reply detailing the outcomes of their investigation to MPI was required. The grower acknowledged the results and agreed to adopt preventive measures to avoid a future MRL breach.

The food risks of these five samples are discussed in Section 4.2.

58.6% (260/444) of the samples had no detectable residues (above the LOR). Overall, 99.1% (439/444) of the samples had ag-chem residues that complied with the relevant New Zealand, Australia or Codex MRLs.

Table 5 details the frequency of 67 residues detected in the samples, categorised by crops. A number of the detected residues were found in domestic and imported samples that may have different applicable MRLs. The different applicable MRLs are further provided in Section 4.3 for specific crops.

Table 5 Detected residues reported in nine selected crops

No.	Residues (sample source)	Total number of detection	Number of residues detected in																
			Apples		Avocados		Kiwi fruit		Grapes		Maize	Melons		Onions		Potatoes	Tomatoes	
			Domestic	Imported	Domestic	Imported	Domestic	Imported	Domestic	Imported	Domestic	Domestic	Imported	Domestic	Imported	Domestic	Domestic	Imported
1	Abamectin	1															1	
2	Acephate	3											2					1
3	Acetamiprid*	2		1						1								
4	Azoxystrobin	1											1					
5	Bifenthrin	5								1							2	2
6	Bitertanol	1															1	
7	Boscalid	18								17					1			
8	Buprofezin	2															2	
9	Captan	33	30						1	1							1	
10	Carbaryl	1	1															
11	Carbendazim	13	2							1							10	
12	Chlorantraniliprole	10	5	1						3			1					
13	Chlorothalonil	13										3	4				4	1
14	Chloropropham	1														1		
15	Chlorpyrifos	10	1		7					1								1
16	Clothianidin	2								2								
17	Cypermethrin	1								1								
18	Cyprodinil	10								10								
19	Diazinon	3	2	1														
20	Difenoconazole	2	1							1								
21	Dimethoate #	5											5					
23	Dodine	11	11															
24	Etoxazole	2			1					1								
25	Fenhexamid	11						1		10								
26	Fenpropathrin*	1								1								

No.	Residues (sample source)	Total number of detection	Number of residues detected in															
			Apples		Avocados		Kiwi fruit		Grapes		Maize	Melons		Onions		Potatoes	Tomatoes	
			Domestic	Imported	Domestic	Imported	Domestic	Imported	Domestic	Imported	Domestic	Domestic	Imported	Domestic	Imported	Domestic	Domestic	Imported
27	Fluazinam	1														1		
28	Fludioxonil	8						1		7								
29	Fluopyram	1															1	
30	Fluvalinate**	1															1	
31	Haloxyfop-etotyl	1									1							
32	Imazalil	6											6					
33	Imidacloprid	17								9			2			2	3	1
34	Indoxacarb	2								2								
35	Iprodione	17					7		1	3							6	
36	Kresoxim-methyl	1								1								
37	Maldison (also termed Malathion)	1							1									
38	Metalaxyl	4											1				3	
39	Methamidophos	5											1	2			1	1
40	Methomyl	8								2			5				1	
41	Methoxyfenozide	14	6		1					7								
42	Myclobutanil	8							1	6			1					
43	Novaluron	1		1														
44	Pencycuron	1												1				
45	Permethrin	2															2	
46	Piperonyl butoxide	25			19											2	4	2
47	Pirimiphos-methyl	4															3	
48	Prochloraz	24			22								2					
49	Procymidone	2															2	
50	Propargite	1											1					
51	Propham	8														8		
52	Proquinazid	4	1							1			1					
53	Pymetrozine	2															2	
54	Pyraclostrobin	15								15								
55	Pyrimethanil	11								11								
56	Pyriproxyfen	1															1	
57	Quinoxyfen	3								3								
58	Spiromesifen	10															10	

No.	Residues (sample source)	Total number of detection	Number of residues detected in															
			Apples		Avocados		Kiwi fruit		Grapes		Maize	Melons		Onions		Potatoes	Tomatoes	
			Domestic	Imported	Domestic	Imported	Domestic	Imported	Domestic	Imported	Domestic	Domestic	Imported	Domestic	Imported	Domestic	Domestic	Imported
59	Spirotetramat	4								3							1	
60	Tebuconazole	6								6								
61	Tebufenozide	25	25															
62	Terbuthylazine	1	1															
63	Tetraconazole*	1								1								
64	Thiacloprid	2	1		1													
65	Triadimenol	9											3	4			1	1
66	Trifloxystrobin*	7								7								
67	Triforine	8															8	
	Subtotal		87	4	51	0	7	2	4	135	1	3	36	7	1	14	71	10
	Total		91		51		9		139		1	39		8		14	81	

Key:

Residues in bold	Group 1 residues detected
▭	Approved Group 1 ag-chem for specific produce group
*	Not a New Zealand ag-chem registration and detected in imported produce
**	This residue is the sum of stereoisomers, reported as total fluvalinate.
#	*Sum of:* Dimethoate and Omethoate *Expressed as:* Dimethoate

The range of residues detected per sample in each crop is summarised in Table 6 below. Maize had one residue detected in one sample, the lowest number of residues detected per sample. By comparison, one grape and one melon sample had up to 9 residues detected per sample.

Table 6 Range and total number of detected residues per sample and produce

Agricultural Crop	Total number of samples analysed	Number of different ag-chem residues detected									
		None	1	2	3	4	5	6	7	8	9
Apple	57	11	17	17	8	4	0	0	0	0	0
Avocado	57	31	5	17	4	0	0	0	0	0	0
Kiwifruit	59	51	7	1	0	0	0	0	0	0	0
Grape	34	2	2	5	4	9	2	4	3	2	1
Maize	37	36	1	0	0	0	0	0	0	0	0
Melon	31	19	4	1	2	2	0	1	0	1	1
Onion	59	51	8	0	0	0	0	0	0	0	0
Potato	59	45	14	0	0	0	0	0	0	0	0
Tomato	51	15	13	7	9	4	2	1	0	0	0
Total	444	261	71	41	27	19	4	6	3	3	2

Of the total reported residue results, detected residues made up <0.22% (437/194,541) and residues that exceeded the MRLs made up only <0.01% (5/194,541). Approximately 41% (182/444) of the produce samples contained detected residue levels above the LOR, but only 1% (5/444) were non-compliant with the MRL.

Table 7 2013-2014 Summary of FRSP residues results

		No Residues Detected		Residues Detected (above LOR)					
Targeted Agricultural Crops	Total number of samples analysed	Number of samples/ Percentage*		Number of samples/ Percentage*		Compliant samples/ Percentage*		Non-compliant samples/ Percentage*	
Apples	57	11	19%	46	81%	46	81%	0	0%
Avocados	57	31	54%	26	46%	26	46%	0	0%
Kiwi fruit	59	51	86%	8	14%	8	14%	0	0%
Grapes	34	2	6%	32	94%	31	91%	1	3%
Maize	37	36	97%	1	3%	1	3%	0	0%
Melons	31	19	61%	12	39%	12	39%	0	0%
Onions	59	51	86%	8	14%	8	14%	0	0%
Potatoes	59	45	76%	14	24%	12	21%	2	3%
Tomatoes	51	15	29%	36	71%	34	62%	2	4%
Total	444	261	59%	183	41%	178	40%	5	1%

*Percent of total samples reported to the nearest whole number

4.2 RISK ASSESSMENT OF RESIDUES EXCEEDING MRLS

4.2.1 Grape - Bifenthrin: 0.14mg/kg

Food consumption data – a conservative approach

An adult consumption value for grapes was derived from grapes for wine production, as this intake is far higher than that for table grapes or grape juice. For children, the mean of table grapes and grape juice intake has been used.

Health based guidance values

ADI and ARfD values of 0.01mg/kg body weight (bw)/day were established by WHO. These were used as the health based guidance values for bifenthrin.

Dietary exposure assessment

In adults, chronic exposure to bifenthrin in the general population equates to less than 2% of the ADI and acute exposure to high consumers equates to 38% of the ARfD. For children, exposure to this residue in the general population equates to less than 0.1% of the ADI and acute exposure to high consumers equates to 8% of the ARfD.

4.2.2 Potato - Fluazinam: 0.03mg/kg

Health based guidance values

No WHO or EPA health based guidance values are sighted for fluazinam, in their absence the ADI of 0.01 mg/kg bw/day and ARfD values of 0.07mg/kg bw set by the European Food Safety Authority have been used.

Dietary exposure assessment

For adults and children, chronic exposure to this residue in the general population equates to less than 0.5% of the ADI and acute exposure to high consumers equates to less than 1% of the ARfD.

4.2.3 Potato - Imidacloprid: 0.03mg/kg

Health based guidance values

An ADI value of 0.06mg/kg of bw/day and an ARfD value of 0.4mg/kg bw were established by WHO. These have been used as the health based guidance values for imidacloprid.

Dietary exposure assessment

In adults, chronic exposure to this residue in the general population equates to less than 0.1% of the ADI and acute exposure to high consumers equates to 0.1% of the ARfD. For children, exposure to this residue in the general population equates to less than 0.2% of the ADI and acute exposure to high consumers equates to 0.2% of the ARfD.

4.2.4 Tomato - Metalaxyl: 0.06mg/kg

Health based guidance values

An ADI value of 0.08mg/kg bw/day was established by WHO. This has been used as the health based guidance value for metalaxyl.

Dietary exposure assessment

For adults and children, chronic exposure to this residue in the general population equates to less than 0.1% of the ADI.

4.2.5 Tomato - Methamidophos: 0.71mg/kg

Health based guidance value

A PDE_{food} value of 0.0001mg/kg bw/day was established by the EPA and an ARfD of 0.01mg/kg bw was established by WHO. These two values have been used as the health based guidance values for methamidophos.

Dietary exposure assessment

In adults and children chronic exposure to this residue in the general population calculates as an exceedance of the PDE_{food} at 520% and 590% respectively. However acute exposure to high consumers equates to 35% and 50% of the ARfD for adults and children respectively.

The levels of exposure risk to adults and children from this ag-chem, are not solely based on the numbers derived from the dietary assessments. To evaluate whether a MRL breach represents an actual food safety risk in terms of chronic exposure, other related factors must be taken into account:

1. Only 2 out of the 51 tomato samples had residues of methamidophos; as such, it is unlikely that exposure will continue on a daily basis.

2. Only 1 out of the 51 tomato samples had residues of methamidophos that exceeded the MRL. As this residue is likely a one-off ocurrence, the exceedance of the PDE_{food} is unlikely to represent a long term exposure pattern.

3. Since the FRSP sampling was finalised, a re-assessment of the controls surrounding methamidophos products has been undertaken. A specific MRL for tomatoes was

established, which legally requires tomato growers to comply with label directions. This would decrease the risk of future MRL breaches in tomatoes.

4. Methamidophos use will cease in 2023, after which exposure through the diet will be minimal.

5. Most importantly, there is no acute food safety risk posed by this residue, such that a one-off consumption could lead to a health risk.

Based on the above interpretations of the methamidophos data in this crop, it is highly unlikely that the calculated exceedance of the PDE for chronic exposure is realistic. The likely chronic dietary risk of the consumer to methamidophos would be negligible.

4.3 ANALYSIS OF REPORTED RESIDUES AGAINST APPLICABLE MRLS

4.3.1 Apples

A total of 59 apple samples were collected and 57 of them were analysed and two were unsuitable. Please refer to Appendix 6.2 for further details of samples deemed unsuitable. The 57 analysed samples were comprised of 56 domestic samples and one imported sample from USA.

Proquinazid, a group 1 ag-chem approved for apple crops, was detected in one apple sample. The other Group 1 ag-chems approved for apple crops, penthiopyrad, fenbuconazole and saflufenacil, were not detected in the apple samples. Captan was the most frequently detected residue, found in thirty domestic apple samples. All of the apple samples complied with the established MRLs and 19% (11/57) of the apple samples had no residues detected (above the LOR).

The number of samples with detected residues below the established MRLs is summarised under the 'Compliant' column in Table 8. In total, 15 types of residues were detected in 81% (46/57) of apple samples (Table 8).

Table 8 Residues detected in apple samples for 2013-2014 FRSP survey

No.	Residues Detected	LOR (mg/kg)	Compliant	Non-Compliant	MRL [a, b, c] (mg/kg)
1	Acetamiprid*	0.01	1	0	0.8[c]
2	Captan	0.01	30	0	10[a]
3	Carbaryl	0.01	1	0	3[a]
4	Carbendazim	0.01	2	0	2[a]
5	Chlorantraniliprole	0.01	6	0	0.3[a]
6	Chlorpyrifos	0.01	1	0	0.2[a]
7	Diazinon	0.01	3	0	0.5[a]
8	Difenoconazole	0.01	1	0	0.1[b]
9	Dodine	0.01	11	0	2[a]
10	Methoxyfenozide	0.02	6	0	0.5[a]
11	Novaluron	0.01	1	0	0.05[a]
12	Proquinazid (Group 1)	0.01	1	0	0.1[a]
13	Tebufenozide	0.01	25	0	0.5[a]
14	Terbuthylazine	0.01	1	0	0.1[b]
15	Thiacloprid	0.01	1	0	0.3[a]

Key:
* Ag chem not registered in New Zealand but detected in imported sample;
LOR = limit of reporting;
Compliant = number of samples (of 57 apples analysed) with residues less than the MRL;
Non-compliant = number of samples (of 57 apples analysed) with residues greater than the MRL;
a = New Zealand MRL; b= default New Zealand MRL; c= Codex MRL.

4.3.2 Avocados

All 57 avocado samples collected and analysed were domestic samples.

Etoxazole, a group 1 ag-chem, was detected in one avocado sample. Uniconazole-p, the other Group 1 ag-chem approved for avocado crops, was not detected in any avocado samples. Prochloraz, a Group 2 ag-chem, was the most frequently detected residue, found in 22 avocado samples. All of the avocado samples complied with the established MRLs and 11% (6/57) of the avocado samples had no residues detected (above the LOR).

The number of samples with detected residues below the applicable MRLs is summarised under the 'Compliant' column of Table 9. Six types of residues were detected in 89% (51/57) of avocado samples. The number of residues found in those avocado samples ranged from one to three residues per sample.

Table 9 Residues detected in avocado samples for 2013-2014 FRSP survey

No.	Residues Detected	LOR (mg/kg)	Compliant	Non-Compliant	MRL [a] (mg/kg)
1	Chlorpyrifos	0.01	7	0	0.02[a]
2	Etoxazole (Group 1)	0.01	1	0	0.1[a]
3	Methoxyfenozide	0.01	1	0	0.1[a]
4	Piperonyl butoxide	0.01	19	0	8[a]
5	Prochloraz	0.01	22	0	5[a]
6	Thiacloprid	0.01	1	0	0.05[a]

Key:
LOR = limit of reporting;
Non-compliant = number of samples (of 57 avocados analysed) with residues greater than the MRL;
Compliant = number of samples (of 57 avocados analysed) with residues less than the MRL;
a = New Zealand MRL.

4.3.3 Kiwi fruit

A total of 59 kiwi fruit samples (including one kiwiberry) were collected and analysed. The analysed samples comprised of 55 domestic samples and four kiwi fruit imported from Italy. The kiwiberry sample had no detectable residues.

Acibenzolar-s-methyl, a group 1 ag-chem approved for kiwi fruit crops, was not detected in any kiwi fruit samples. Iprodione, a Group 2 ag-chem, was the most frequently detected residue, found in seven domestic kiwi fruit samples. All of the kiwi fruit samples complied with the established MRLs. 86% (51/59) of the kiwi fruit samples had no residues detected (above the LOR).

The number of samples with detected residues below the applicable MRLs is summarised under the 'Compliant' column of Table 10. Three types of residues were detected in 14% (8/57) of kiwifruit samples (Table 10). The number of residues found in those kiwi fruit samples ranged from one to two residues per sample.

Table 10 Residues detected in kiwifruit samples for 2013-2014 FRSP survey

No.	Residues detected	LOR (mg/kg)	Compliant	Non- Compliant	MRL[a,c] (mg/kg)
1	Fenhexamid*	0.01	1	0	15[c]
2	Fludioxonil*	0.01	1	0	15[c]
3	Iprodione	0.01	7	0	5[a]

Key:
* = Ag chem not registered in New Zealand but detected in imported sample;
LOR = limit of reporting;
Compliant = number of samples (of 59 kiwi fruits analysed) with residues less than the MRL;
Non-compliant = number of samples (of 59 kiwi fruits analysed) with residues greater than the MRL;
a = New Zealand MRL; c= Codex MRL.

4.3.4 Grapes

A total of 34 grape samples were collected and analysed. The samples comprised of one domestic sample and 33 imported samples from Australia (5 samples), Chile (15 samples), Mexico (3 samples) and USA (10 samples).

Proquinazid, a Group 1 ag-chem, was detected in one imported grape sample. Boscalid, a Group 2 ag-chem, was the most frequently detected residue, found in 17 imported grape samples. 97% (33/34) of the grape samples complied with the established MRLs and 6% (2/34) of the grape samples had no residues detected (above the LOR). Two imported grape samples with no residues detected were from Chile and Mexico.

Bifenthrin, a Group 2 ag-chem, was detected in one imported sample (Table 11). There is no established bifenthrin MRL for grapes in CODEX or the New Zealand standard code. The default New Zealand MRL was applied to the level of bifenthrin reported and the sample was considered as non-compliant. The importer was notified of the result and reminded of their legal obligation to supply food to the New Zealand public that complies with the New Zealand food standards.

The number of residues detected in the grape samples, below the applicable MRLs, is summarised under the 'Compliant' column of Table 11. Thirty-one types of residues were detected in 94% (32/34) of grape samples. The number of residues found in the grape samples ranged from one to nine residues per sample.

Table 11 Residues detected in grape samples for 2013-2014 FRSP survey

No.	Residues Detected	LOR (mg/kg)	Compliant	Non-compliant	Non-compliant Residue Amount (mg/kg)	MRL[a, b,c,d] (mg/kg)
1	Acetamiprid	0.01	1	0	-	0.5[c]
2	Bifenthrin	0.01	0	1	0.14	0.1[b]
3	Boscalid	0.01	17	0	-	5[a]
4.1	Captan (domestic)	0.05	1	0	-	10[a]
4.2	Captan (imports)	0.05	1	0	-	10[d]
5	Carbendazim	0.01	1	0	-	3[c]
6	Chlorantraniliprole	0.01	3	0	-	0.1[b]
7	Chlorpyrifos	0.01	1	0	-	0.5[c]
8	Clothianidin	0.01	2	0	-	0.7[c]
9	Cypermethrin	0.01	1	0	-	0.2[c]
10	Cyprodinil	0.01	10	0	-	3[c]
11	Difenoconazole	0.01	1	0	-	0.1[c]
12	Etoxazole	0.01	1	0	-	0.5[c]
13	Fenhexamid	0.01	10	0	-	15[c]
14	Fenpropathrin	0.01	1	0	-	5[c]
15	Fludioxonil	0.01	7	0	-	2[c]
16	Imidacloprid	0.01	9	0	-	1[c]
17	Indoxacarb	0.01	2	0	-	2[c]
18.1	Iprodione (domestic)	0.01	1	0	-	10[a]
18.2	Iprodione (imported)	0.01	3	0	-	10[c]
19	Kresoxim-methyl	0.01	1	0	-	1[c]
20	Maldison (also known as Malathion)	0.01	1	0	-	0.1[b]
21	Methomyl	0.01	2	0	-	0.5[a]
22	Methoxyfenozide	0.01	7	0	-	1[c]
23.1	Myclobutanil (domestic)	0.01	1	0	-	1[c]
23.2	Myclobutanil (imported)	0.01	6	0	-	1[c]
24	Proquinazid (Group 1)	0.01	1	0	-	0.5[d]
25	Pyraclostrobin	0.01	15	0	-	2[c]
26	Pyrimethanil	0.01	11	0	-	4[c]
27	Quinoxyfen	0.01	3	0	-	2[c]
28	Spirotetramat	0.01	3	0	-	2[c]

29	Tebuconazole	0.01	6	0	-	6[c]
31	Trifloxystrobin	0.01	7	0	-	3[c]

Key:

- = Not applicable;

LOR = limit of reporting;

Compliant = number of samples (of 34 grapes analysed) with residues less than the MRL;

Non-compliant = number of samples (of 34 grapes analysed) with residues greater than the MRL;

a = New Zealand MRL; b= default New Zealand MRL (0.1mg/kg); c= Codex MRL; d=Australia MRL.

4.3.5 Maize

There were 40 maize samples collected and 37 maize samples were analysed. For the discrepancy between the number of samples collected and analysed, please refer to Appendix 6.2. All the maize samples were domestic.

Saflufenacil, a Group 1 ag-chem approved for New Zealand maize crop, was not detected in any maize sample. Only haloxyfop-etotyl, a Group 2 ag-chem, was detected in one maize sample. All of the maize samples complied with the established MRL. 97% (36/37) of maize samples had no residues detected (above the LOR). The number of samples with detected residues below the default New Zealand MRL is summarised under the 'Compliant' column of Table 12.

Table 12 Residues detected in maize samples for 2013-2014 FRSP

Residue detected	LOR (mg/kg)	Compliant	Non-compliant	MRL [b] (mg/kg)
Haloxyfop-etotyl	0.01	1	0	0.1[b]

Key:
LOR = limit of reporting;
Compliant = number of samples (of 37 maize analysed) with residues less than the MRL;
Non-compliant = number of samples (of 37 maize analysed) with residues greater than the MRL;
b= default New Zealand MRL (0.1mg/kg).

4.3.6 Melons

A total of 31 melon samples (cantaloupe, watermelon, honeydew and melon) were collected and analysed. The samples comprised of 20 domestic samples and 11 imported samples from Australia (9 samples) and Tonga (2 samples).

Proquinazid, a Group 1 ag-chem approved for New Zealand melons, was detected in one melon sample. Chlorothalonil, a Group 2 ag-chem, was the most frequently detected residue, found in seven domestic and imported melon samples (from Australia). All of the melon samples complied with the established MRLs. 61% (19/31) of the melon samples had no residues detected (above the LOR).

The number of samples with detected residues below the applicable MRLs is summarised under the 'Compliant' column of Table 13. Sixteen types of residues were detected in 39% (12/31) of melon samples. Thirteen residues were detected in seven Australian melons and four residues in two Tongan melons. The number of residues found in individual melon samples ranged from one to nine residues per sample.

Table 13 Residues detected in melon samples for 2013-2014 FRSP survey

No.	Residue Detected	LOR (mg/kg)	Compliant	Non-compliant	MRL[a, b, c, d,] (mg/kg)
1	Acephate	0.01	2	0	0.5[d]
2	Azoxystrobin	0.01	1	0	1[d]
3	Chlorantraniliprole	0.01	1	0	0.2[d]
4	Chlorothalonil	0.01	7	0	5[a]
5	Dimethoate [#]	0.01	5	0	5[d]
6	Imazalil	0.01	6	0	10[d]
7	Imidacloprid	0.01	2	0	0.2[d]
8	Metalaxyl	0.01	1	0	0.2[d]
9	Methamidophos	0.01	1	0	0.2[a]
10	Methomyl	0.01	5	0	0.1[d]
11	Myclobutanil	0.01	1	0	0.1[b]
12	Prochloraz	0.01	2	0	7[c]
13	Propargite (import)	0.01	1	0	2[d]
14	Proquinazid (Group 1)	0.01	1	0	0.2[d]
15	Triadimenol	0.01	3	0	0.5[d]

Key:
LOR = limit of reporting;
Compliant = number of samples (of 31 melon analysed) with residues less than the MRL;
Non-compliant = number of samples (of 31 melon analysed) with residues greater than the MRL;
a = New Zealand MRL; b= default New Zealand MRL (0.1mg/kg); c= Codex MRL; d=Australia MRL
# = *Sum of:* Dimethoate and Omethoate *Expressed as:* Dimethoate

4.3.7 Onions

A total of 59 onion samples were collected and analysed. The samples comprised of 56 domestic samples and three imported from USA.

Fluopyram, a Group 1 ag-chem approved for New Zealand onion crop, was not detected in any onion samples. Triadimenol, a Group 2 ag-chem, was the most frequently detected residue, found in four onion samples. All of the onion samples complied with the established MRLs and 86% (51/59) of the onion samples had no residues detected (above the LOR).

The number of samples with detected residues below the applicable MRLs is summarised in the 'Compliant' column of Table 14. Four types of residues were detected in 14% (8/59) of the onion samples.

Table 14 Residues detected in onion samples for 2013-2014 FRSP survey

No.	Residues Detected	LOR (mg/kg)	Compliant	Non-compliant	MRL[a, b,c] (mg/kg)
1	Boscalid	0.01	1	0	5[c]
2	Methamidophos	0.01	2	0	0.1[b]
3	Pencycuron	0.01	1	0	0.1[b]
4	Triadimenol	0.01	4	0	0.2[a]

Key:
LOR = limit of reporting;
Compliant = number of samples (of 59 onion analysed) with residues less than the MRL.
Non-compliant = number of samples (of 59 onion analysed) with residues greater than the MRL.
a = New Zealand MRL; b= default New Zealand MRL (0.1mg/kg); c=Codex MRL

4.3.8 Potatoes

All the 59 potato samples collected and analysed were domestic samples.

No residues of acrinathrin and ametoctradin, approved for potato crops in New Zealand, were detected in any potato samples. Propham was the most frequently detected residue, found in seven potato samples. Imidacloprid was detected above the New Zealand MRL in <2% (1/59) of the potato samples. Fluazinam was detected above the New Zealand MRL in a different potato sample. Two potato producers were identified for the non-compliant samples and both were notified of their non-compliant results separately.

Four other detectable residues were found in 12 samples, but were below the applicable MRLs, as shown in the 'Compliant' column of Table 15. There was 76% (45/59) of the potato samples that had no residues detected (above the LOR) but five types of residues were detected in 14 (24%) potato samples.

Table 15 Residues detected in potato samples for 2013-2014 FRSP survey

No.	Residues Detected	LOR (mg/kg)	Compliant	Non-compliant	Non-compliant Residue Amount (mg/kg)	MRL[a, b] (mg/kg)
1	Chlorporpham	0.01	1	0	-	50[a]
2	Fluazinam	0.01	0	1	0.03	0.02[a]
3	Imidacloprid	0.01	1	1	0.03	0.02[a]
4	Piperonyl butoxide	0.01	2	0	-	8[a]
5	Propham	0.01	8	0	-	50[a]

Key:
LOR = limit of reporting.
Compliant = number of samples (of 59 potato analysed) with residues less than the MRL (compliant).
Non-compliant = number of samples (of 59 potato analysed) with residues less than the MRL.
- = Not Applicable
a = New Zealand MRL; b= default New Zealand MRL (0.1mg/kg);

4.3.9 Tomatoes

A total of 51 tomato samples (inclusive of four cherry tomato samples) were collected and analysed. The samples were comprised of 47 domestic samples and four imported samples from Australia.

Triticonazole and acrinathrin, Group 1 ag-chems approved for New Zealand tomato crops, were not detected in any tomato samples. However, fluopyram, a Group 1 ag-chem, was found in one domestic tomato sample. Carbendazim, a Group 2 ag-chem, was the most frequently detected residue, found in ten domestic tomato samples.

Thirty four types of detectable residues were found in 36 samples. >94% (34/36) of samples were below the applicable MRLs, as shown in the 'Compliant' column of Table 16. Two residue amounts that breached the applicable MRLs can be found in column labelled as 'Non-compliant' in Table 16. These two residues were found in two different tomato samples.

One sample (FRSP 440) had methamidophos residue that breached the default MRL with a residue level of 0.71 mg/kg. The tomato grower that supplied the sample that breached the methamidophos MRL was notified of the non-compliant result and a formal reply by the grower was requested. The evidence and reply presented by the grower suggested that this was a single incident rather than a systemic issue of the grower mis-using the ag-chem or inappropriate withholding periods. MPI has closed the case without further actions required from the grower.

A different tomato sample (FRSP 453) had metalaxyl residue that breached the MRL. The tomato grower that supplied that metalaxyl positive sample was also notified of the breached metalaxyl residue result and reminded of his legal obligation to sell food that complies with the New Zealand MRLs.

34% (19/444) of the tomato samples did not have any residues detected (above LOR). The range of residues found in those tomato samples was one to six residues per sample.

Table 16 Residues detected in tomato samples for 2013-2014 FRSP survey

No.	Residue Detected	LOR (mg/kg)	Compliant	Non-compliant	Non-compliant Residue Amount (mg/kg)	MRL[a, b, c , d]
1	Abamectin	0.01	1	0	-	0.1[b]
2	Acephate	0.01	1	0	-	1[a]
3.1	Bifenthrin (import)	0.01	2	0	-	0.5[d]
3.2	Bifenthrin (domestic)	0.01	2	0	-	0.05[a]
4	Bitertanol	0.01	1	0	-	0.1[b]
5	Buprofezin	0.01	2	0	-	0.5[a]
6	Captan	0.01	1	0	-	10[a]
7	Carbendazim	0.01	10	0	-	2[a]
8.1	Chlorothalonil (import)	0.01	1	0	-	
8.2	Chlorothalonil (domestic)	0.01	4	0	-	5[a]
9	Chlorpyrifos	0.01	1	0	-	0.2[a]
10	Fluopyram (Group 1)	0.01	1	0	-	0.1[b]
11	Fluvalinate	0.01	1	0	-	0.1[b]
12	Imidacloprid	0.01	4	0	-	0.1[b]
13	Iprodione	0.01	6	0	-	5[a]
14	Metalaxyl	0.01	2	1	0.06	0.05[a]
15.1	Methamidophos (import)	0.01	1	0	-	2[d]
15.2	Methamidophos (domestic)	0.01	0	1	0.71	0.1[b]
16	Methomyl	0.01	1	0	-	0.5[a]
17	Permethrin	0.01	2	0	-	0.5[a]
18	Piperonyl butoxide	0.01	6	0	-	8[a]
19	Pirimiphos-methyl	0.01	3	0	-	1[a]
20	Procymidone	0.01	2	0	-	1[a]
21	Pymetrozine	0.01	2	0	-	0.5[a]
22	Pyriproxyfen	0.01	1	0	-	1[a]
23	Spiromesifen	0.01	10	0	-	0.5[a]
24	Spirotetramat	0.01	1	0	-	0.3[a]
25	Triadimenol	0.01	2	0	-	0.1[b]
26	Triforine	0.01	8	0	-	2[a]

Key:

LOR = limit of reporting.

Compliant = number of samples of Tomato (out of 51 analysed) with residues less than the MRL.

a = New Zealand MRL; b= default New Zealand MRL (0.1mg/kg); c= Codex MRL; d=Australia MRL.

5 CONCLUSION

The 2013-2014 FRSP survey was designed to give an overview of the levels of ag-chem residues in agricultural produce. This overview shows the high level of compliance with GAP by New Zealand horticultural growers and that of importers, supplying imported produce to the New Zealand public, complying with the permitted MRLs.

In the 2013-2014 monitoring programme, Group 1 ag-chems were identified as pesticides that were approved for crop use in 2011/12. The purpose of screening samples for Group 1 ag-chems was to find out if the growers and producers were using the newly approved pesticides correctly and in accordance to label claim. The rest of the ag-chem compounds, that formed Group 2 ag-chems, were compounds that were previously screened in 2011/12. By repeating the previous year's multi-screen, MPI would form a baseline to monitor the ongoing use of different ag-chems. This will enable MPI to compare the detected ag-chems on various crops in future surveys.

The compliance level of ag-chem residues found in produce has been an ongoing interest of New Zealand consumers and importing partners/countries for a number of years. The 2013-2014 survey has detected residues of Group 1 ag-chems in 1.4% (6/444) of the samples. However, they were all below the permitted MRLs. The residue levels detected generally leads MPI to the conclusion that the proper application and post-harvest intervals are observed, indicating compliance with GAP by New Zealand growers.

For Group 2 ag-chems that were screened in the samples, <1% (4/444) of the analysed samples had levels that were non-compliant with the permitted MRLs. They were:

- bifenthrin (0.14 mg/kg) in grapes (from Chile),
- fluazinam (0.03 mg/kg) in potatoes (from New Zealand)
- imidacloprid (0.03 mg/kg) in potatoes (from New Zealand),
- metalaxyl (0.06 mg/kg) in tomatoes (from New Zealand) and
- methamidophos (0.71 mg/kg) in tomatoes (from New Zealand)

The degree of the MRL non-compliances ranged from 0.03 – 0.71 mg/kg in the five samples analysed. Methamidophos detected in the domestic tomato was calculated to have a potential exceedance of the chronic health guidance value. However, based upon further assessment and analysis, it is considered there is negligible long term risk from exposure to methamidophos from consuming tomatoes. The lack of realistic long-term exposure risk was determined based on the following factors:

1. Only a single non-compliance has been detected and as a one-off exposure it would not be representative of the normal long-term exposure to methamidophos necessary for consideration of the long-term dietary risk.
2. Methamidophos was detected in only two of the 51 tomato samples analysed, this indicates exposure to methamidophos will occur infrequently.

3. In the time since the FRSP sampling was finalised, a reassessment of the controls surrounding methamidophos products has been undertaken. Growers are required to observe legal compliance with label direction. The risk of future MRL breaches will decrease.
4. Methamidophos use will cease in 2023 after which exposure through the diet will be minimal.

Furthermore, wide margins of safety are factored in when an MRL of any ag-chem is set by the competent authorities. A residue that was non-compliant with the MRL should not be considered a food safety hazard without further food exposure risk assessment. Samples were taken in their fresh, whole and unwashed state, and processed upon arrival at the laboratory. Processing studies on several crops report a proportion of the residue of methamidophos is washed off the outside of fruit with water, as such, home normal preparation will likely reduce the residue further.

MPI will continue to monitor the situation and include screening of methamidophos in New Zealand produce in future surveys where appropriate. MPI will also continue to review international best practices in food safety and GAP, review applicable MRLs and revisit the inclusion of these food groups in future residue and contaminant surveys in the intermediate to long term studies.

6 APPENDIX

APPENDIX 6.1 PESTICIDE SUITE OF AG-CHEM RESIDUES

Table 17 List of all ag-chem residues analysed in 2013-2014 FRSP survey

Residues	Residues	Residues	Residues
Abamectin	Bromobutide	Clethodim	Dichloran
Acephate	Bromophos	Clodinafop-propargyl	Dichlorvos
Acetamiprid	Bromophos-ethyl	Clofentezine	Diclobutrazol
Acetochlor	Bromopropylate	Clomazone	Diclocymet
Acibenzolar-S-methyl	Bupirimate	Cloquintocet-mexyl	Diclofop-methyl
Acifluorfen	Buprofezin	Clothianidin	Diclosulam
Acrinathrin	Butachlor	Coumafos	Dicofol
Alachor	Butafenacil	Coumaphos oxon	Dicrotophos
Alanycarb	Butamifos	Cyanazine	Dieldrin
Aldicarb	Cadusafos	Cyanophos	Diethofencarb
Aldicarb-sulfone	Cafenstrole	Cyazofamid	Difenoconazole
Aldicarb-sulfoxide	Captan	Cyclanilide	Diflubenzuron
Aldrin	Carbaryl	Cycloate	Diflufenican
Allidochlor	Carbendazim	Cyclosulfamuron	Dimepiperate
Ametoctradin	Carbetamide	Cyflufenamid	Dimethenamid
Ametryn	Carbofuran	Cyfluthrin	Dimethoate
Anilofos	Carboxin	Cyhalofop-butyl	Dimethomorph
Atrazine	Carfentrazone-ethyl	Cyhalothrin	Dimethylvinphos
Azaconazole	Carpropamid	Cymoxanil	Dioxabenzofos
Azamethiphos	Chlorantraniliprole	Cypermethrin	Dioxathion
Azinphos-methyl	Chlorbufam	Cyproconazole	Diphenamid
Azoxystrobin	Chlordane (cis)	Cyprodinil	Diphenylamine
Benalaxyl	Chlordane (trans)	Cyromazine	Disulfoton
Bendiocarb	Chlorfenapyr	Daimuron	Dithiopyr
Benfluralin	Chlorfenvinphos	DDD (o,p')	Diuron
Benfuracarb	Chloridazon	DDD (p,p')	Dodine
Benodanil	Chlorimuron-ethyl	DDE (o,p')	Edifenphos
Benoxacor	Chlorobenzilate	DDE (p,p')	Emamectin Benzoate
Bensulfuron-methyl	Chlorothalonil	DDT (o,p')	Endosulfan (alpha)
Bensulide	Chlorotoluron	DDT (p,p')	Endosulfan (beta)
BHC (alpha)	Chloroxuron	Deltamethrin	Endosulfan sulphate
BHC (beta)	Chlorpropham	Demeton-s-methyl	Endrin
BHC (delta)	Chlorpyrifos	Demeton-s-methyl-sulfoxide	EPN
Bifenox	Chlorpyrifos-methyl	Desmedipham	Epoxiconazole
Bifenthrin	Chlorsulfuron	Di-allate	EPTC
Bioresmethrin	Chlorthal-dimethyl	Diazinon	Esfenvalerate
Bitertanol	Chlozolinate	Dichlobenil	Esprocarb
Boscalid	Chromafenozide	Dichlofenthion	Ethalfluralin
Bromacil	Cinidon-ethyl	Dichlofluanid	Ethametsulfuron-methyl

Ethiofencarb	Flamprop-methyl	Hexaflumuron	Methabenzthiazuron
Ethion	Flazasulfuron	Hexazinone	Methacrifos
Ethiprole	Fluacrypyrim	Hexythiazox	Methamidophos
Ethoprofos	Fluazifop-p-butyl	Imazalil	Methidathion
Ethoxyquin	Fluazinam	Imazamethabenz-methyl	Methiocarb
Ethoxysulfuron	Flucythrinate	Imazosulfuron	Methomyl
Ethychlozate	Fludioxonil	Imidacloprid	Methoxyfenozide
Etobenzanid	Flufenacet	Inabenfide	Metobromuron
Etoxazole	Flumiclorac pentyl	Indanofan	Metolachlor
Etridiazole	Flumioxazin	Indoxacarb	Metominostrobin (E)
Etrimfos	Fluometuron	Iodofenphos	Metominostrobin (Z)
Famoxadone	Fluopicolide	Iodosulfuron-methyl	Metribuzin
Famphur	Fluopyram	Iprobenfos	Mevinphos
Fenamidone	Fluquinconazole	Iprodione	Milbemectin
Fenamiphos	Fluridone	Iprovalicarb	Molinate
Fenarimol	Flusilazole	Isazophos	Monocrotophos
Fenbuconazole	Flusulfamide	Isofenphos	Monolinuron
Fenchlorphos	Fluthiacet-methyl	Isofenphos-methyl	Myclobutanil
Fenhexamid	Flutolanil	Isoprocarb	Napropamide
Fenitrothion	Flutriafol	Isoprothiolane	Nicotine
Fenobucarb	Fluvalinate (total)	Isoproturon	Nitrofen
Fenothiocarb	Folpet	Isoxathion	Nitrothal-isopropyl
Fenoxanil	Fomesafen	Karbutilate	Norflurazon
Fenoxaprop	Fonofos	Kresoxim-methyl	Novaluron
Fenoxaprop-ethyl	Forchlorfenuron	Lactofen	Omethoate
Fenoxycarb	Formetanate hydrochloride	Lenacil	Oryzalin
Fenpiclonil	Fosthiazate	Leptophos	Oxabentrinil
Fenpropathrin	Fuberidazole	Lindane	Oxadiazon
Fenpropimorph	Furalaxyl	Linuron	Oxadixyl
Fenpyroximate	Furametpyr	Lufenuron	Oxamyl
Fensulfothion	Furathiocarb	Malathion	Oxycarboxin
Fenthion	Halosulfuron-methyl	Mandipropamid	Oxyfluorfen
Fenthion sulfone	Haloxyfop-etotyl	Mefenacet	Paclobutrazol
Fenthion sulfoxide	Haloxyfop-methyl	Mefenpyr-diethyl	Parathion
Fentrazamide	Heptachlor epoxide	Mepanipyrim	Parathion-methyl
Fenvalerate	Heptachlor	Mepronil	Penconazole
Ferimzone	Heptenophos	Metalaxyl	Pencycuron
Fipronil	Hexachlorobenzene	Metamitron	Pendimethalin
Flamprop	Hexaconazole	Metconazole	Penthiopyrad

Permethrin	Pyrazophos	Temephos	Triticonazole
Phenmedipham	Pyributicarb	Tepraloxydim	Uniconazole P
Phenthoate	Pyridaben	Terbacil	Vamidothion
Phorate	Pyridafenthion	Terbufos	Vinclozolin
Phorate sulphone	Pyrifenox	Terbumeton	XMC
Phorate sulphoxide	Pyriftalid	Terbutryn	Zoxamide
Phosalone	Pyrimethanil	Terbutylazine	
Phosmet	Pyrimidifen	Tetrachlorvinphos	
Phosphamidon	Pyriminobac-methyl(E)	Tetraconazole	
Phoxim	Pyriminobac-methyl(Z)	Tetradifon	
Picolinafen	Pyriproxyfen	Thenylchlor	
Piperonyl butoxide	Pyroquilon	Thiabendazole	
Piperophos	Pyroxsulam	Thiacloprid	
Pirimicarb	Quinalphos	Thiamethoxam	
Pirimiphos-methyl	Quinoclamine	Thiazopyr	
Pretilachlor	Quinoxyfen	Thidiazuron	
Prochloraz	Quintozene	Thiobencarb	
Procymidone	Quizalofop-ethyl	Thiocyclam hydrogenoxalate	
Profenofos	Rimsulfuron	Thiometon	
Promecarb	Saflufenacil	Tiadinil	
Prometryn	Sethoxydim	Tolclofos-methyl	
Propachlor	Simazine	Tolylfluanid	
Propamocarb	Simeconazole	Tralkoxydim	
Propanil	Simetryn	Triadimefon	
Propaphos	Spinetoram	Triadimenol	
Propaquizafop	Spinosad	Triallate	
Propargite	Spiromesifen	Triasulfuron	
Propazine	Spiromesifen-enol	Triazophos	
Propetamphos	Spirotetramat	Tribenuron-methyl	
Propham	Spiroxamine	Tribuphos	
Propiconazole	Sulfentrazone	Trichlorfon	
Propoxur	Sulprofos	Tricyclazole	
Propyzamide	Tebuconazole	Trifloxystrobin	
Proquinazid	Tebufenozide	Trifloxysulfuron sodium	
Prosulfocarb	Tebufenpyrad	Triflumizole	
Prothiofos	Tebuthiuron	Triflumuron	
Pymetrozine	Tecnazene	Trifluralin	
Pyraclostrobin	Tefluthrin	Triflusulfuron-methyl	
Pyraflufen ethyl	Telflubenzuron	Triforine	
Permethrin	Pyrazophos	Temephos	
Phenmedipham	Pyributicarb	Tepraloxydim	

APPENDIX 6.2 FRSP SAMPLING PLAN

FRSP designed a sampling plan based on statistical analysis of historical production and import volumes reports. However, these historical reports cannot predict the year to year variation of crop availability, crop production volume, and import volume for the current year. Thus, the sampling collection activity deviated slightly from the sampling plan, <7% (32/482) of the planned samples were not collected.

Another 1.2% (6/482) of the collected samples were lost during the delivery to the testing laboratory. Finally, <0.5% (1/482) of the samples were deemed unsuitable for analysis by the laboratory upon arrival. A total of 444 samples were analysed and reported for ag-chem residues.

Table 18 Sampling design: numbers of samples that were planned, collected and analysed for 2013-2014 FRSP survey

Agricultural Crop	Planned Samples	Collected Samples	Total Samples Analysed
Apples	59	59[a]	57
Avocados	59	57[b]	57
Kiwi fruit and kiwiberry	59	59	59
Grapes	34	34	34
Maize	59[c]	40[b]	37[f]
Melons	34[d]	31	31
Onions	59	59	59
Potatoes	59	59	59
Tomatoes	60[e]	52	51[f]
Total	**482**	**450**	**444**

Key:

a) Two apple samples were deemed unsuitable by the laboratory upon arrival. The apple season was over by the time when re-sampling was organized.

b) No avocados and maize were imported in 2013, compared with 2012.

c) In 2012 where a percentage of maize in New Zealand was imported for domestic starch production. There was no imported maize available for sampling during the 2013-2014 FRSP survey sampling period.

d) Samplers were unable to locate different growers without sample duplication. Most imported melons were from a few growers overseas.

e) Planned samples included imported Australian tomatoes and hot-house tomatoes from certain New Zealand regions. As the sampling commenced, Australian tomatoes imports were delayed and arrived after the sampling period was over. The hot-house tomato season ended prior to planned sampling dates.

f) Three maize and one tomato samples were lost during delivery and there was a breakdown in communication between the samplers and laboratory. This was not discovered until the sampling period was closed. Moving forward, there will be measures put in place to avoid future occurrence.

APPENDIX 6.3 FRSP SAMPLE UNITS AND WEIGHTS

Table 19 Minimum sample units and weight required for nine selected agricultural crops

Classification	Agricultural Crops	Minimum sample units and weight required for one sample
Assorted tropical and sub-tropical fruits – inedible peel	Kiwi fruit/Avocado	1 kg (at least 10 units)
Berries and other small fruit	(1) Kiwiberries (2) Grapes (bunches)	(1) 1 kg (at least 100 units) (2) 2 kg (at least 5 units)
Bulb vegetables	Onions	1kg (at least 10 units)
Cereal grains / grasses	Maize (Whole, including: husk, kernel and cob)	1 kg (at least 10 units)
Curcubits- fruiting vegetables	Melons	2kg (at least 5 units)
Fruiting vegetables other than cucurbits	Tomatoes	1kg (at least 10 units)
Pome fruit	Apples	1kg (at least 10 units)
Root and tuber vegetables	Potatoes	1kg (at least 10 units)