Program 2010-2314-TO

Pesticide Use by Market Gardeners
Final Report

Abstract

In 2010, the Pest Management Regulatory Agency (PMRA) inspected market gardeners in six regions across Canada (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Quebec) to assess compliance with the Pest Control Products Act and its Regulations. Approximately half of the inspected growers possessed expired products and/or used herbicides, insecticides and fungicides for a non-registered use. Non-compliance with personal protective equipment (PPE) was also found. The main challenge to compliance in the market gardener sector is that when many products are used, there is a greater chance for expiry of products to occur, and it may be hard to keep track of multiple product directions. Non-compliance was addressed using written education. Re-sampling and future inspection activities will be carried out in this sector in the next few years.

National Pesticides Compliance Program - 2014

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Background

Market gardening is a subsector of fresh fruit and vegetable production and has a distinct marketing strategy: growers market their fresh fruit and vegetable crops directly to the consumer on-site at the farm, at nearby roadside stalls, or at a farmer's market, without any involvement of packers, wholesaler, retailers and restaurants. Market gardens may be run in conjunction with other income earning strategies, such as growing cash crops and agritourism activities (e.g. U-pick operations).

The popularity of market gardens stretches across most of the country and production is increasing; for example, in Ontario, 85% of on-farm markets are growing or producing the same amount, or more produce, than they did the previous year[1]. An approximate distribution of market gardeners across Canada is shown in Table 1. Most provinces have associations to support market gardeners, which include the British Columbia (BC) Association of Farmers' Market, Alberta Farm Fresh Producers Association, Agricultural Producers Association of Saskatchewan, Farmers' Markets Association of Manitoba, Ontario Farm Fresh Marketing Association and l'Association des producteurs maraîchers du Québec.

Table 1: Distribution of market gardeners in 2009[2]

BC	Alberta	Saskatchewan	Manitoba	Ontario	Quebec
550	668	200	200	750	595

Market garden operations are unique in that they often grow a wide variety of crops; however, the acreage of each individual crop is frequently small. Given these multiple smaller planting areas, growers may be tempted to use a broad spectrum product on multiple crops, regardless of the crop uses stated on the label. Minor (low acreage) or micro (young, predominately cotyledon stage) crops can make up their repertoire and fewer registrations for these crops can lead to unregistered and off-label pesticide use. The variety of crops grown, also provides for a larger variety of pesticide products in storage. Multiple crops, successive planting, hand weeding and harvesting in this industry necessitates the need to record and follow restricted entry intervals (REI) and pre-harvest intervals (PHI). Public access to these farms further emphasizes the requirement to abide by REI's and PHI's.

Some compliance history in the fresh fruit and vegetable sector, relevant to the subsector of market gardening, is available from past National Pesticide Compliance Programs. Regional reports for the 2009-2010 Agritourism and U-Pick Operations Program, which included inspections of fruit crops grown for on-farm sale, indicated three off-label uses, expired/unregistered products in storage, and non-licensed applicators. The 2003-2004 Pesticide Use on Asian Vegetable Production Program, which inspected vegetable farms with multiple cropping practices, also found off-label uses, confirmed via sampling results, which were attributed to spray drift, or misuse of registered products. Given that the market gardeners are from the same regulated communities, the same types of non-compliance could be expected to be found in the Market Gardeners Program.

[1] On Farm Marketing in Ontario 2009 Report, Ontario Farm Fresh Marketing Association

[2] Provincial Ministry of Agriculture websites

Objectives

- To assess information regarding pesticide use by market gardeners.
- To assess current farm practices regarding restricted entry intervals (REI), pre-harvest intervals (PHI), personal protective equipment (PPE) and drift management.
- To promote compliance by providing growers with information on the *Pest Control Products Act (PCPA).*
- To identify any specific compliance issues in the market gardening community.

Program Delivery

Between May and October of 2010, inspectors collected information about pesticide use by market gardeners through the administration of the finalized questionnaire. Most of the questions were non-product specific; however, there was one question that required inspectors to choose a recently used product, and ask the grower about label requirements with respect to this product use specifically. The questionnaire for this program was developed in consultation with the Environmental Assessment Directorate (EAD) and focused on buffer zones and drift management practices.

At the time of inspections, market gardeners were informed of the requirements of the *Pest Control Products Act* and its Regulations, including the requirement to follow label directions. The following fact sheets were provided: *Use According to Label Directions, Respecting Pre-harvest and Restricted Entry Intervals, Pesticide Spray Drift in Residential Areas, Pesticides and Food*, *Protect Yourself.*

Sampling was carried out in BC, Ontario and Quebec, where multi-crop farms are more common, and where there was a greater chance of off-label use of pesticide products occurring with an increasing number of crops. Leaf samples were obtained in accordance with standard sampling procedures from the Field Operating Manual, and were not crop-specific, allowing for greater flexibility in choosing farms for inspection. Samples were sent to the laboratory in Ottawa for multi-residue screening analysis.

Table 2 indicates the number of planned and actual inspections and samples that were carried out across Canada. In the Alberta region, three additional market gardener inspections were carried out in the Yukon, as part of Alberta's assumed responsibility for the Northern Region. The shortfall in Saskatchewan was not noticed until it was too late in the growing season to inspect another farm.

Table 2: Market gardener inspections for 2010-2011

Activity	BC	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	Total
Inspections planned	20	15	6	10	20	20	91
Inspections carried out	20	18	5	10	20	21	94
Samples	20	-	-	-	20	21	61

Results

Description of Farms Inspected

The market gardener farms inspected across the country ranged greatly in size, from less than one hectare to 1050 hectares. Farms were smaller in BC (11 hectares on average), compared to all other regions; for example, in Ontario and Quebec, farms were an average of 99 and 56 hectares, respectively.

In BC, Ontario and Quebec, most of the market gardeners grew their crops on a working farm, and had a market garden vendor stand on site. Farms in these regions also devoted a larger portion of their farmland to market gardening in comparison to Alberta, Manitoba and Saskatchewan, and in addition, grew a wider variety of market garden crops. In Alberta, Manitoba and Saskatchewan, only about one half of the inspected farms had stands on site; it was just as common to sell crops at a farmer's market. Generally, about one half of the inspected farms in every region had pick-your-own crops.

There were approximately 100 different varieties of crops grown on the inspected farms. The most commonly grown market garden crops were tomatoes and beans (61 farms each), where beans included white, kidney, romano, faba and snap. Other commonly grown crops were sweet corn (51), cucumber (47), field and greenhouse peppers (43), winter and summer squash (38), raspberries (36), potatoes (35), and cabbage (35), where cabbage included savoy, green, head, napa and red, and strawberries (30). Aside from the two berries, these commonly grown crops were produced in all six regions. Outside of market garden crops, some of the more commonly grown crops on these farms included wheat, soybeans, oats, and field corn.

Pest Control Product Use by Market Gardeners

Pest control products were used by 82 of the 94 farms inspected, and included insecticides, herbicides, fungicides and rodenticides. Pest control products were generally applied by the farm owner or manager. In Ontario and Quebec, these applicators had pesticide applicator licenses, whereas in BC, Alberta, Saskatchewan and Manitoba, less than one half of the applicators had any type of certification.

- Non-compliant Storage and Use

About one half of all growers using PCPs (40/82 = 49%) had non-compliant products found in storage (Table 3). The 168 non-compliant products found in storage were mainly expired products, but also included five United States Environmental Protection Agency products, seven products not registered for use in the region where they were found, and three products missing labels.

In addition, about one half of all growers reported a non-compliant use. Both the declared non-compliant uses (122) and the positive sampling results (27) are further described in Appendix 1. When registered products were used, they were used for registered uses in 91% (1266/1388) of declared cases. This means that the product was used for the correct crop and pest outlined on the label the vast majority of the time.

It should be noted that this assessment of compliance with storage and use is based on the producer's self-declaration of use and memory. Often there was no spray log and very seldom did the producer refer to notes when asked about the current season's uses. The rates of compliance are therefore only estimates.

Misuse of insecticides was most common (63 misuses), followed by fungicides (52 misuses) and herbicides (34 misuses). The most commonly misused actives were copper, mancozeb, s-metalochlor/r-enantiomer, cypermethrin and deltamethrin. The crops on which products were most commonly misapplied were: cabbage, tomatoes, cucumbers, peppers and strawberries. These are all amongst the most commonly grown market garden crops, so there is an increased chance for non-compliance.

In BC, Ontario and Quebec, there were more products found on market garden farms than in the other regions. This may explain the lower rates of compliance with products in storage and with use of products according to the label; there was a greater chance for expiry of products to occur, and it may have been hard to keep track of multiple product directions.

Table 3: Storage and use of pest control products by market gardeners

	BC	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	Total
Number of inspections	20	18	5	10	20	21	94
Number of growers using PCPs *	17	12	3	9	20	21	82
Number of products in storage	331	62	10	88	549	580	1620
Average number of products per grower using PCPs	19.4	5.2	3.3	9.8	27.5	27.6	17.8
Compliance of growers with registered uses	12/17 = 71%	10/12 = 84%	2/3 = 67%	5/9 = 56%	9/20 = 45%	6/21= 29%	44/82 = 54%

Compliance of products with registered uses	288/297 = 97%	45/47 = 96%	9/10 = 90%	44/52 = 85%	384/425 = 90%	496/557 = 89%	1266/1388 = 91%
Compliance of growers with storage	5/17 = 29%	11/12 = 92%	3/3 = 100%	8/9 = 89%	5/18 = 28%	8/21 = 38%	40/82 = 49%
Compliance of products in storage	271/331 = 82%	58/62 = 94%	10/10 = 100%	86/88 = 98%	484/549 = 88%	543/580 = 94%	1452/1620 = 90%

- ***** Where the number of growers using pest control products (PCPs) is less than the number of inspections, the difference is with organic growers who did not use or store PCPs in the 2010 use season; these growers may have used PCPs in the past, or may in the future, as there are pesticides registered for use in organic production.

Sampling Results

Eighteen out of the 60 samples taken for this inspection program revealed a potential off-label use of a pest control product (refer to Appendix 1). Several other samples contained low levels of actives not registered for the crop, but could not definitively be linked to misuse. The results were hard to interpret for several reasons. For example, a low level found in a sample may not demonstrate misuse, but rather the fact that the active is persistent. Additionally, low levels can be attributed to drift, but this depends on the analysis of the context of the application, the surrounding fields, how they may be separated, the declared uses in those surrounding fields, and environmental factors like rain, sun, wind, etc.

- Aside from the detection of cypermethrin in two Quebec samples, all of the unregistered uses discovered via the sampling results, were not reported during the delivery of the questionnaire.

Characteristics of Non-compliant Market Gardeners

To determine characteristics that may be linked with the level of non-compliance, a subset of data was created of growers found to be non-compliant due to storage of unregistered pest control products, and declared unregistered use (Appendix II). For these 43 growers, the number of non-compliant events was compared against the total farm size, the size of farmland dedicated to market gardening, the percent of land used for market gardening, and the number of market garden crops grown. The only trend found was for number of market garden crops grown. Generally, market gardeners who grew more crops also had more instances of non-compliance.

Rate of Compliance with Label Directions

Personal Protective Equipment

Growers listed personal protective equipment (PPE) worn during mixing/loading and application in general terms, but it was difficult to determine their level of compliance with PPE, as PPE requirements differ depending on the product used. However, one of the common requirements for all products is gloves during mixing/loading. Some type of body protection (rain suit/coveralls/long sleeved shirt and pants) is also often required during pesticide application. Therefore, an approximation of compliance with PPE is the proportion of growers wearing gloves during mixing/loading (87% of growers) and long sleeved shirt and pants or the equivalent (75% of growers) during pesticide application (Table 4).

Table 4: Approximation of compliance with PPE

Indicator of compliance	BC	AB	SK	MB	ON	QC	Overall
Gloves worn during mixing/loading	17/17	12/12	5/5	8/9	16/20	15/21	73/84 = 87%
Long shirt/pants worn during application	15/17	12/12	5/5	8/9	15/20	16/21	71/84 = 85%
Overall	32/34 = 94%	24/24 = 100%	10/10 = 100%	16/18 = 89%	31/40 = 78%	31/42 = 74%	144/168 = 86%

The PPE worn and reported by growers is likely an overestimate; for example, one grower reported a face shield was worn for application, when no face shield was found on the premises. It is difficult to determine if the differences in PPE being worn across regions can be attributable to a specific reason (for example, more label requirements to keep track of in Ontario and Quebec with more products being used).

The information reported about PPE worn for a specific product (Table 5) was a better indicator of the state of compliance with PPE as compliance was verified with the product label. The lower rates of compliance with PPE reported via this question (72% in Table 5 as opposed to 86% in Table 4) suggest that growers are likely over-reporting the PPE worn.

Table 5: Compliance with label requirements by region

Requirement	BC	AB	SK	MB	ON	QC	Overall
PPE	15/18	11/11	2/3	7/7	11/13	5/19	51/71 = 72%
REI	17/18	10/10	3/3	6/6	14/15	15/19	65/71 = 92%
PHI	15/17	10/10	2/3	7/7	9/12	15/18	58/67 = 87%
Application rate	16/18	10/10	2/3	8/8	9/13	14/19	59/71 = 83%

Buffer zone	4/5	5/5	1/1	3/3	4/7	6/13	23/34 = 67%
Overall	67/76 = 88%	46/46 = 100%	10/13 = 77%	31/31 = 100%	47/60 = 78%	55/88 = 63%	256/314 = 82%

Restricted Entry Intervals, Pre-Harvest Intervals and Application Rates

REI, PHI and applications rates reported in reference to a specific product, showed that growers were fairly compliant. Ninety-two percent, 87% and 83% of growers followed these requirements, respectively (Table 5).

Drift and Buffer Zones

The question that asked about buffer zones in reference to a specific product showed an overall rate of compliance of 67%, with lower rates of compliance in Ontario and Quebec. This may be due to the fact that farms in Ontario and Quebec have more sensitive habitat surrounding their farms to contend with. Out of the forty-five market gardeners who identified sensitive habitat that was close to their farms, 33 were in Ontario or Quebec. Types of sensitive habitats included woodlots, shelter belts, hedgerows, houses, beehives, other crops, creeks, rivers, reservoirs, water wells and trout farms.

Out of the 45 farms with sensitive habitat, only six reported that buffer zone instructions impacted their pesticide application practics, such as needing to wait to spray until a non-windy day, or not being able to apply the product where required. A few growers identified that buffer zones were simply not followed. This is an indication that a question in reference to a specific product may provide a better picture of the real compliance situation.

There was an awareness for the protection of aquatic habitats. Every grower (except one in BC) who reported having aquatic habitat on their farm, also indicated that they either left uncropped land between field and aquatic habitat, or used a backpack sprayer (exempting them from the buffer zone requirements on a label). Three quarters of these growers reported the width of uncropped land left was over five metres.

Sensitive habitats may also be protected via grower techniques to reduce spray drift; 100% of pesticide users who were asked about drift, reported following some technique to reduce drift to adjacent crops or sensitive areas, usually related to timing and weather. Some growers said they spray in the early morning or evening when drift is least likely to occur (73 growers), some growers said they do not spray on windy days (72 growers), and some growers said they do not spray on hot dry days (58 growers). Using reduced travel speeds (51 growers) and keeping the boom close to spray targets (47 growers) were other popular techniques reported. Label recommendations to avoid drift were only followed by 43 growers. Forty-two farmers reported that their sprayer is configured to reduce spray drift, utilizing cone spray shields; shielded booms; and low drift nozzles.

Compliance by Product Type

As with choosing a registered product for a registered use, growers showed the highest rate of compliance with the label requirements on herbicide labels, which generally had fewer precautions (Table 6). The lowest rate of compliance was seen with the use of fungicides.

Table 6: Compliance with label requirements by product type

Requirement	Insecticide	Herbicide	Fungicide	Overall
PPE	33/41	8/11	10/19	51/71 = 72%
REI	37/40	10/11	18/20	65/71 = 92%
PHI	33/39	9/10	16/18	58/67 = 87%
Application rate	33/41	10/11	16/19	59/71 = 83%
Buffer zone	10/15	4/5	9/14	23/34 = 67%
Overall	146/176 = 83%	41/48 = 85%	69/90 = 77%	256/314 = 82%

Information sources/records

Only 20 growers reported using the label as their source for PPE information. Most made choices based on the product characteristics (such as active ingredient, dust versus liquid, etc.), what was used in the previous season, or wore full PPE for every type of product application. For example, growers may use more PPE and/or use a closed cab for insecticides in comparison to herbicides.

Many more growers (76 in total) reported using the label for information like REI and PHI. They also consulted the production guide (56 growers), a chemical salesperson (32 growers) or an agronomist or extension specialist (24 growers. Using these types of resources (versus the PMRA label search) is the risk of missing information on any updated requirements due to label modifications or re-evaluations.

It also appeared that growers consulted sources for the purposes of protecting workers and the public. Of all growers employing workers at their farm, about two thirds reported using the label, or the restricted entry interval, to determine when workers are allowed to enter a treated field. The other third gave non-specific answers, e.g. after 48 hours, which suggests the same REI may be used for all applications, regardless of the product. Workers are generally given verbal notification of the REI, in English in all regions, except in Quebec where notification is given in French. Only nine growers reported communicating to their workers in an additional language, six growers in Spanish, and three in German.

Record keeping by growers differed between regions. In BC and Ontario, almost all growers kept track of their application information using spray records, an agronomist, or a calendar. In Alberta, Manitoba, Saskatchewan and Quebec, only half of growers kept written records. The other half claimed to keep track of multiple REI's and PHI's by memory.

Knowledge, Willingness and Ability

Knowledge in the market gardening sector varied, depending on whether the correct label was on a product, and whether the label was read. Language was also a barrier. Many growers did not know that products had expired or where to discard expired products. Fortunately, the educational component of this program addressed this gap, in communicating disposal information.

Growers responded well to the educational component of this program, which shows their willingness to comply. Some of the questions posed to inspectors included how better spray records could be kept; how buffer zones were determined; what to do if a customer ever complained about pesticide use; and how to reduce chemical application. Growers wanted to avoid misuse because they are conscientious of the health of their clients. However, with respect to compliance with PPE requirements, willingness to use PPE declined when the weather was warm, since it was uncomfortable.

Some of the growers inspected in this program identified gaps in product availability in Canada and allowable uses of registered pesticides. For example, registered products that exist in the marketplace can be efficacious for uses (crop and pest) not approved on the label. There can be a strong financial incentive not to comply with label requirements when these gaps exist.

Follow-up to Non-Compliance

Expired products and unregistered product uses found through inspections were tracked in the PMRA's Compliance Results Tracking (CRT) database. In addition, regions created a CRT entry for sample results that were suspected to be violations.

Generally, non-compliant growers were sent written education for all violations. Follow-up on sample results was done in the same manner, but was delayed because of lab results becoming available a year after the inspection took place. Eight surveillance inspections were completed.

Because growers did not always have a cost effective avenue for disposing of obsolete pesticides, this was considered in the enforcement response (i.e. the timelines outlined in the letter by which disposal of a given product must take place). For example, the obsolete pesticides "Clean Farms" program run by CropLife runs on a 4 year rotation, and at the time of inspection (2010), it was not due to return in Ontario until 2013.

Outcomes/Conclusions

The objectives for the 2010-2314 Targeted Oversight Program on Pesticide Use by Market Gardeners were met. Inspectors were able to assess pesticide use by market gardeners, as well as current farm practices regarding REIs, PHIs, PPE and drift management, via inspections.

Ninety-one percent of reported pesticide applications were of a registered product on a registered crop/pest. Growers read label directions for crops and pests, although with multiple crops, it was sometimes difficult for growers to keep track of all applications. Only about one half of the growers inspected were 100% compliant with storage and use of a pesticide for a registered crop.

Eighty-two percent of label requirements for PPE, REI, PHI, application rates and buffer zones were complied with. Many growers did not realise there was a legal obligation to follow the various safety requirements outlined on the label in addition to crop/pest for use.

Factors affecting the rates of compliance were the following:

1. Number of crops grown: Compliance decreased with the number of crops grown. More crops meant more product use, more products to keep track of, and more possibilities for off-label use. Crops that were commonly grown, and involved in the greatest number of misuses, were cabbage, tomatoes, cucumbers, peppers and strawberries.

2. Region: Compliance was lower in British Columbia, Ontario and Quebec, in comparison to the Prairies Provinces. Growers in these provinces tended to grow a higher number of different crops.

3. Product Type: Misuse of pest control products due to an off-label application (crop or pest) was highest with insecticides, followed by fungicides, and herbicides. Some of the most commonly misused actives were copper, mancozeb, s-metalochlor/r-enantiomer, cypermethrin and deltamethrin.

Compliance promotion was able to address some of the knowledge barriers to compliance (e.g. disposal, obligation to follow instructions concerning personal protective equipment or sensitive habitat).

Growers were also educated on the reasons for applying pesticides as per the label directions. These reasons can include health and safety of workers and bystanders and also the marketability of the crop. The gaps in product availability can be minimized through programs like Health Canada's Minor Use Program. Not only do programs like these give growers access to more products, but they can help address some of the regional compliance concerns.

Recommendations

Program delivery of this type of National Pesticide Compliance Program (NPCP) should be improved as follows:

- A team meeting should be held prior to commencement of program delivery to plan consistent responses to non-compliance and tracking of non-compliance.
- The PPE handout should be distributed and discussed for all inspections. Growers will then be educated on the risks of not wearing PPE, even if they over report PPE worn. Alternatively, the PPE questions could be worded in a way to better emphasize these risks.

Follow-up activity for the Pesticide Use by Market Gardeners NPCP should include:

- Sharing of Appendix I, which shows the commonly misused actives and products, with the PMRA science directorates. A summary of the buffer zone questions and responses should be shared with EAD.
- Continued assistance from the EAD and Health Evaluation Directorate to evaluate the risk of reported off-label uses and to support the enforcement responses taken.
- Continued communication between the regions and Minor Use groups, as minor use crops provide some challenges in this sector due to a lack of product registrations.
- Development of programs to address regional concerns. For example, these could include regions in which growers commonly grow cabbage, tomatoes, cucumbers, peppers and strawberries, the crops to which PCP's were most commonly misapplied.
- Polling of Regional Pesticide Officers to determine if German handouts may be useful.

Appendix I: Non-compliance with pest control product (PCP) with respect to a registered crop x pest combination

Products *in italics* are no longer registered for ANY use.
In the majority of the detected misuses, the product has been identified either by product in inventory, producer declaration at time of inspection, or through later communications.
* Actives detected from sampling results do not have product associated with misuse.

Active	Number of misuses	Product	PCP registration number	Details of misuse		
Fungicides						
Benomyl	1	*Benlate Wettable Powder*	*11062*	QC	1	Strawberry
Chlorothalonil	5	Bravo	unknown	ON	2	unknown (cabbage diamond back moths, cabbage loopers)
		Bravo 500	15723	QC	1	Pepper (27 ppm)
		unknown	n/a	ON	1	Apple (0.1-1 ppm)
		unknown	n/a	ON	1	Pepper (18 ppm)
Copper	10	Kocide 2000	27348	QC	8	Cabbage, cucumber, eggplant, melon, netted melon, pumpkin, squash
		Parasol Flowable	25901	QC	1	Cabbage
		Parasol WG	29063	QC	1	Zucchinis
Cymoxanil	1	Curzate 60 DF	26284	QC	1	Tomato
Dodine	1	Equal 65WP	15608	QC	1	Strawberry
Fenamidone	1	Reason 500 SC	27462	ON	1	Tomatoes
Famoxadone	7	Tanos 50DF	27435	QC	7	Tomato, Chilli pepper (0.044 ppm), Pepper (17 ppm), Red cabbage (1.8 ppm), Tomato (1 to 10 ppm)
Iprodione	6	Rovrol Wettable Powder	15213	MB, QC	5	Cabbage, netted melon, pumpkin, squash, Cucumber (0.1-1 ppm)
		unknown	n/a	ON	1	Pepper (0.16 ppm)
Mancozeb	10	Dithane F-45	20552	MB	1	Cabbage
		Dithane M-45 80% WP	8556	BC	2	Apricots, peaches
		Manzate DF	21057	QC	1	Strawberry
		Manzate Pro-Stick	28217	QC	6	Cabbage, eggplant, pepper
Metriam	2	Polyram DF Water Dispersible Granualar	20087	QC	2	Cucumber, pepper
Myclobutanil	2	Nova 40W Agricultural	22399	ON	1	Squash
		unknown	n/a	QC	1	Cucumber (0.1-1 ppm)
Propiconazole	1	Jade Fungicide	24030	ON	1	Grains
Pyrimethanil	2	Scala SC	28011	QC	1	Field Tomato
		unknown	n/a	ON	1	Peaches (0.022 ppm)
Thiophanate-methyl	1	Senator 70WP	25343	QC	1	Onion
Captan, Diazinon, Gamma-BHC from Lindane	1	*Agrox D-L Plus Seed Treatment Powder*	*10896*	BC	1	Spinach seeds
Cyprodinil, Fludioxonil	4	Switch 62.5 WG	28189	QC	1	Apple
Herbicides						
2, 4 DB-Ethyhexyl ester	1	*Caliber 400*	*16736*	ON	1	Strawberry
2, 4-D	3	IPCO 2,4-D Amine 600 Liquid	17511	QC	1	Strawberry
		Marks 2,4-D 2EH 564	27859	ON	1	Strawberry
Amitrole	1	Amitrol 240 Liquid	25684	ON	1	Asparagus
Atrazine-desethyl*	1	unknown	n/a	ON	1	Tomato (0.014 ppm)

Bromoxynil	2	Nufarm Koril 235 Liquid	25341	ON	1	Leeks
		Pardner	18001	ON	1	Sweet corn
Clomazone	3	*Command 360 ME*	*27370*	ON, QC	3	Cucumber, pumpkin, soybean
Clopyralid	1	Lontrel 360	23545	ON	1	Corn
Dicamba	1	Banvel II	23957	MB	1	Sweet corn
Fluazifop-p-butyl	1	Venture L	21209	QC	1	Leek
MCPA	2	IPCO MCPA Amine 500 Liquid	20308	QC	2	Lawn, strawberry
Metribuzin	3	Sencor	17242 or 26280	ON	1	Faba beans
		Sencor 480 F Flowable	26280	QC	1	Field Tomato
		Sencor 500 Flowable	14867	ON	1	Field Tomato
Oxyfluorfen	1	Goal 2XL Emulsifiable Concentrate	24913	ON	1	Leeks
Pendimethalin	2	Prowl 400 EC	23439	ON	2	Gladiolus, sunflowers
S-Metolachlor and R-Enantiomer	8	Dual II Magnum	25729	ON, QC	8	Cucumbers, fababeans, lettuce, peas, onions, Romano beans, tomatoes
Terbacil*	1	unknown	n/a	ON	1	Tomatoes (0.03 ppm)
Trifluran	2	Bonanza 400 Liquid	21967	ON	1	Rapini
		Trifluralin 10G	21522	ON	1	Beans
Dicamba, 2, 4-D, Mecoprop	2	*Trillion Liquid Turf*	*18963*	QC	1	Lawn
		Weed-Away Premium 3-Way	*18865*	QC	1	Lawn
Insecticides						
Azinphos-methyl	5	Guthion 50 WSB Wettable Powder Crop	21374	ON	2	Potatoes, tomatoes
		Sniper	23323	QC	3	Cabbage
Bifenazate	1	Acramite	27925	QC	1	Cucumber (0.01-0.1 ppm)
Carbaryl	2	Manchester Bug Killer Dust	11514	ON	2	Cucumbers, melons
Chlorpyrifos	3	Citadel 480EC	27479	QC	1	lawn around the residence
		Lorsban	Unknown	ON	2	Cherries, plums
Cyfluthrin	1	Tempo 20 WP	25673	SK	1	Cabbage
Cyhalothrin-lambda	2	Matador 120EC	24984	QC	1	Pepper (0.054 ppm)
		unknown *	n/a	ON	1	Pepper (0.72 ppm)
Cypermethrin	11	Ripcord 400EC Agricultural	15738	ON,	9	Peppers (reported and 0.54 ppm), cucumbers (reported and 25 ppm),

				QC		squash
		unknown *	n/a	ON	1	Cucumber (0.6 ppm)
		unknown *	n/a	ON	1	Pumpkin (7.7 ppm)
Deltamethrin	10	Decis	unknown	ON	4	Beans, beets, cucumbers, zucchinis
		Decis 5 EC	17734	AB, MB	6	Beans, sweet corn, cucumbers, peppers, Saskatoon
Diazinon	3	Diazinon 500E	11889	BC, QC	2	Raspberries (Spotted Wing Drosophila), lawn residential
		Diazinon 50 W	19576	BC	1	Apples (Thrips)
Dimethoate	3	*Cygon 480-E Systemic*	*14767*	QC	1	Lettuce
		Farm & Ranch Brand Dimethoate 480 EC Systemic	12864	BC	1	Cherries
		Lagon 480 E	9382	ON	1	Raspberries
Endosulfan	5	*Endosulfan 400E*	*27021*	BC	1	Peaches
		Thionex EC Commercial	23453	QC	2	Apple, onion
		unknown (endosulfan sulphate)	n/a	BC	1	Blueberry (0.099 ppm)
		unknown (endosulfan-beta)	n/a	BC	1	Blueberry (0.046 ppm)
Imidacloprid	2	unknown	n/a	BC	1	Apricot (0.44 ppm)
		unknown	n/a	BC	1	Plum (0.14 ppm)
Malathion	6	Malathion 500 Emulsifiable Concentrate	5821	AB, ON, QC	4	Raspberries, strawberries
		Malathion 500E	4709	BC	1	Walnut
		Malathion 85E	*8372*	BC	1	Raspberries (Leafroller)
Naled	1	Dibrom	7442	QC	1	Sweet corn
Permethrin	4	Buzz-Up Crawling Insect Killer	27305	QC	1	Firewood
		Pounce 384 EC	16688	QC	2	Eggplant, zucchini (0.05 ppm)
		unknown *	n/a	ON	1	Pumpkin (0.0074 ppm)
Phosmet	1	Imidan 50WP 23006	23006	QC	1	Cucumber (11 ppm)
Pirimicarb	1	*Pirimor 50WP Dry Flowable*	*22792*	QC	1	Pumpkin
Potassium salts of fatty acids	2	Safer's Soap Concentrate	14669	QC	2	Onions, raspberry
Pyrethrins, Potassium Salts of Fatty Acids	1	Safer's Trounce Concentrate	24363	QC	1	Sweet corn

Appendix II: Growers with non-compliant storage and use of pest control products

Region	Size of farm (ha)	Percent of land devoted to market gardens (MG)	Size of MG farm (ha)	Number of crops grown	Crops with off-label uses	Number of instances non-compliant storage	Number of misuses from inspection	Number of misuses from sampling	Number of offences total (storage and use)
ON	40	72	29	70	strawberries, peas, onions, lettuce, faba beans, tomatoes	20	5	1	26
QC	9	100	9	14	lettuce, leek, melon, pumpkin, cucumber, squash	10	7		17
ON	40	60	24	19	raspberries, sunflowers, Gladiolus, squash, peppers, cucumbers, tomatoes, faba beans, Romano beans	4	12	1	17
QC	72	100	72	15	strawberry, raspberry, corn, onion, lawn	4	10	1	15
BC	1	100	1	9		15			15
QC	73	6	4	14	lawn, tomato, firewood, pepper	5	7	1	13
BC	8	100	8	10	spinach seeds	11	1		12
QC	24	100	24	10	netted melon, pumpkin, squash, onions, eggplant, peppe	3	8		11
QC	19	15	3	12	pepper, cucumber, apple		5	5	10
BC	170	5	41	11	peaches, apricots, apples	6	3		9
ON	71	24	14	8	strawberries, sweet corn, grain	6	3		9
ON	16	20	16	10	beans, beets, cucumbers, zucchini, tomatoes, potatoes		7	1	8
ON	6	100	0	7	rapini, melons, cucumbers	5	3		8
QC	28	100	28	14	lawn, pepper, tomatoes, apple, chilli pepper	1	5	1	7
QC	40	25	10	9	cabbage, lawn	1	5	1	7
ON	81	54	44	6		7			7
ON	101	16	16	13		7			7
BC	5	100	5	6	Peach, walnut	5	2		7
QC	25	93	24	8	cabbage	5	1		6
ON	61	15	9	17	cherries, plums, peaches	2	2	1	5
QC	132	90	118	15	raspberry, cabbage, tomato	2	3		5
QC	54	64	35	12	strawberry	1	3		4
BC	16	2	0	12	plum	4		1	5
BC	3	10	0	12		5			5
AB	65	25	16	1	Saskatoon	4	1		5
QC	40	100	40	17	eggplant, zucchini	1	2	1	4
QC	38	100	38	15	lawn, pumpkins	2	2		4
ON	212	8	17	10	asparagus, apple	2	1	1	4
ON	40	79	32	15		4			4
MB	3	31	1	13	peppers, cucumbers, beans, corn		4		4
BC	4	100	4	7		4			4
BC	2	100	2	4	cherries	3	1		4
QC	14	72	10	14	peppers		1	2	3
QC	20	100	20	17	pepper	1	1	1	3
ON	40	46	19	7	corn	2	1		3
ON	34	100	34	9	pepper			3	3
ON	243	100	243	6	squash, soybeans, leeks		3		3
ON	445	9	40	17		3			3
BC	30	100	30	12		3			3
BC	9	50	5	5		3			3
ON	85	60	51	8	cabbages (pests), beans		3		3
QC	40	12.4	5	4	strawberry	1	1		2
ON	61	27	16	6		2			2
ON	76	27	20	13	leeks	1	1		2
ON	18	20	4	3	pumpkin			2	2
MB	101	100	101	10	cabbage		2		2
BC	2	40	1	5	blueberry			2	2
BC	2	30	1	2	raspberries		2		2
SK	3	100	3	10	cabbage		1		1
MB	607	1	6	8	sweet corn		1		1
MB	30	100	30	4	sweet corn		1		1
MB	73	1	1	36		2			2
BC	6	33	2	4	apricot			1	1

BC	12	100	12	5		1			1
AB	324	20	29	10	strawberry		1		1
					Total	167	122	27	149