

# **Overview of 2013 Pesticide Sales in Alberta**

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**Policy & Planning Division**

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# **Overview of 2013 Pesticide Sales in Alberta**

**Alberta Environment & Parks**

## **EXECUTIVE SUMMARY**

Alberta Environment and Parks undertook the collection, consolidation and analysis of pesticide sales data from pesticide vendors in Alberta for the 2013 calendar year. The objective was to document the volume and types of pesticides sold in Alberta, and to prepare a general overview of the sales data in relation to sectors of use, types of use, individual active ingredients, chemical groupings, as well as geographic breakdowns by river basin, municipality and Land Use Framework region. This information is used to support environmental monitoring programs, and policy assessment. This project is an ongoing survey conducted every five years, with previous reporting undertaken for the years 1993, 1998, 2003 and 2008. The 1998 report followed the chemical grouping format used by Quebec in their reporting on pesticide sales in their province, and with the proposed National Pesticide Sales Database. The 2003, 2008 and 2013 reports also included individual active ingredient sales information as well as sales by chemical group.

Pesticide sales data for 2013 was requested from registered wholesale and retail pesticide vendors in Alberta in early 2014, under the authority of the *Environmental Protection and Enhancement Act* and supporting regulations. Approximately 93% compliance with the sales data request was obtained. Sales data was received as digital spreadsheets or paper records, and was digitized or reformatted to a standardized format. Six additional datasets were utilized to assist with sorting and categorizing the sales records by chemical or geographic groups. The datasets were brought into Microsoft Access<sup>®</sup>, where they were linked and various queries were performed. All sales data reported on in this report is based upon pesticide active ingredient, not formulated product.

In 2013, a total of 15 231 071.5 kg of pesticide active ingredient (ai) was sold in, or shipped into, Alberta. Pesticides sold into the Agriculture sector accounted for 95.3% of all pesticides sold, with the Commercial/Industrial sector accounting for 2.0% of sales, and the Domestic sector accounting for 2.7% of sales. The types of pesticides sold were predominantly herbicides, at 86.7%. Adjuvants and surfactants made up the next largest category at 6.6%. Insecticides made up 1.3% of sales, while fungicides made up 5.3% of sales.

Of the chemical groups, the Phosphonic Acids, Phosphinic Acids group was the largest at 61.9% of overall sales by active ingredient. Sales in this group were made up primarily of glyphosate. However, in the Domestic sector, the Miscellaneous group dominated with 82.9% of pesticide active ingredient (mainly corn gluten meal) sold.

Looking at geographic distribution of sales by outlet location related to major river drainage, sales in the North Saskatchewan River basin were highest overall at 16.6% of the total active ingredient sold, followed by sales within the Battle River basin at 15.9%, and the Red Deer River basin at 15.2%.

Pesticide sales were also sorted by natural regions. The Grassland Natural Region constituted over 43% of all pesticide active ingredient sales, mainly in the Dry Mixedgrass and Mixedgrass sub regions. The Parkland Natural Region contained almost 40% of provincial pesticide sales, mainly in the Central Parkland sub-region. The majority of the remainder of pesticide sales was in the Dry Mixedwood sub-region of the Boreal Natural Region.

Geo-administrative regions were also summarized, for use in program planning. Land Use Framework regions (established prior to the 2008 report) were mapped along with reported sales. The South Saskatchewan region had over 34% of total sales by active ingredient, with the North Saskatchewan region having over 30% of sales.

The rural municipalities with the highest total pesticide sales were Vermilion River, Cypress, Forty Mile, Lethbridge, Flagstaff, Vulcan and Wheatland at over 500 000 kg of active ingredient each. Other rural municipalities with over 300 000 kg ai of pesticide sales were Camrose, Taber, Grande Prairie, Kneehill, Spirit River, Special Area 3, Rocky View and Minburn.

Agricultural pesticide use intensities of over 2.0 kg ai/ha were estimated for the rural municipalities of Vermilion, Lethbridge, Flagstaff and Cypress, based upon their cropped acreage and agricultural pesticide sales. This compares to an overall provincial estimated agricultural pesticide use intensity (based upon cultivated land acreage) of 1.33 kg ai/ha, considerably higher than the 1.02 kg ai/ha use intensity calculated for 2008, and much higher than the 0.78 kg ai/ha agricultural pesticide use intensity calculated for 2003. While the County of Forty Mile had reported sales of over 500 000 kg ai, use intensity was 1.90 kg ai/ha.

The overview of pesticide sales data for Alberta has provided Alberta Environment and Parks and other agencies with the background data to enable comparisons to other regions, and to assist in ensuring that Alberta Environment and Parks has the appropriate regulatory framework in place for pesticides. The data will also be useful in identifying monitoring priorities for ongoing and upcoming monitoring programs.

## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	i
1.0 INTRODUCTION.....	1
2.0 METHODS.....	2
2.1 Sales Data.....	2
Sales Data Collection .....	2
Sales Data Limitations.....	2
2.2 Pesticide Databases.....	4
2.3 Geographic Databases .....	4
2.4 Data Processing .....	5
2.5 Data Breakdown.....	5
2.5.1 Type of Use .....	5
2.5.2 Chemical Group.....	6
2.5.3 Sector of Use .....	7
2.5.4 Geographic Units.....	7
2.5.4.1 River Basins.....	7
2.5.4.2 Natural Regions .....	8
2.5.4.3 Land Use Framework .....	8
2.5.4.4 Municipalities .....	9
2.6 Use Intensity.....	9
3.0 RESULTS.....	10
3.1 Type of Use.....	10
3.2 Chemical Group .....	11
3.3 Sector of Use.....	13
3.3.1 Agricultural Sector .....	13
3.3.2 Domestic Sector.....	16
3.3.3 Commercial/Industrial Sector.....	19
3.3.4 Other Sectors .....	21
3.4 Geographic Distributions .....	22
3.4.1 Drainage Basin .....	22
3.4.1.1 Agricultural Usage.....	22
3.4.1.2 Domestic Pesticide Sales by River Basin .....	22
3.4.2 Pesticide Sales by Natural Region .....	23
3.4.3 Pesticide Sales by Municipality .....	25
4.0 DISCUSSION.....	32
4.1 Use Intensity-Alberta.....	32
4.2 Pesticide Use – Other Regions .....	33
4.3 Selected Herbicide Sales.....	35
4.4 Agricultural Insecticides.....	36
4.5 Spatial Data.....	37
5.0 CONCLUSIONS .....	38
6.0 REFERENCES .....	39

Appendix 1. Chemical Groups and Active Ingredients - 2013 .....	41
Appendix 2. Alberta (2013), Quebec (2011) and Canada (2011) Pesticide Sales by Chemical Group .....	49
Appendix 3. Alberta 1998, 2003, 2008 and 2013 Pesticide Sales by Active Ingredient .....	51
Appendix 4. 2013 Pesticide Sales by Active Ingredient (kg) and River Basin.....	68

## TABLES

Table 1. Pesticide Sales by Type of Use.....	10
Table 2. Summary of Pesticide Sales by Chemical Group (all sectors) .....	11
Table 3. Pesticide Sales by Sector .....	13
Table 4. Top 15 Agricultural Active Ingredients Sold in 2013, 2008, 2003 and 1998.....	14
Table 5. Summary of Agricultural Pesticide Sales by Chemical Group.....	15
Table 6. Summary of Domestic Pesticide Sales by Chemical Group – 2008 & 2013.....	17
Table 7. Top 15 Domestic Active Ingredients Sold in 2013, 2008, 2003 and 1998 .....	19
Table 8. Top 15 Commercial/Industrial Active Ingredients Sold in 2013 2008, 2003 and 1998 .....	20
Table 9. Summary of Commercial/Industrial Pesticide Sales by Chemical Group – 2013 & 2008 .....	20
Table 10. Agricultural Pesticide Sales (excluding adjuvants) by River Basin .....	22
Table 11. Total Domestic Pesticide Sales by River Basin.....	23
Table 12. Total Pesticide Sales by Natural Region .....	24
Table 13. Total Pesticide Sales by Land Use Framework Region.....	25
Table 14. Breakdown for Selected Municipalities of 2011 Crop (ha), Agricultural Pesticide Sales (2013 kg ai >500 000 kg), and Use Intensity (kg ai/ha).....	26
Table 15. Total Pesticide Sales by Municipality (2013).....	27
Table 16. Agricultural Pesticide use comparisons 1988-2013 (excluding adjuvants) .....	32
Table 17. Total Pesticide Sales by Type of Use for Alberta and Quebec .....	34



## FIGURES

Figure 1. Agriculture Sector – Type of Use .....	13
Figure 2. Domestic Sector – Type of Use.....	17
Figure 3. Commercial/Industrial Sector – Type of Use.....	19
Figure 4. Total Agricultural Pesticide Sales (excluding adjuvants) By River Basin ('000 kg ai) - 2013 .....	28
Figure 5. Total Pesticide Sales by Natural Regions and Subregions (kg ai) - 2013 .....	29
Figure 6. Total Pesticide Sales by Land Use Framework Region (kg ai) – 2013.....	30
Figure 7. Total Pesticide Sales by Municipality ('000 kg ai) - 2013.....	31
Figure 8. Selected Herbicide Sales (1988-2013) .....	36

## **1.0 INTRODUCTION**

Alberta Environment and Parks has been collecting pesticide sales data on a regular basis since 1993. Initial data collection (Cotton and Byrtus 1995) focused on agricultural sales from 1988 to 1993 and was utilized to inform the pesticide monitoring in surface waters carried out by Alberta Environment (Anderson 2005) and Alberta Agriculture and Rural Development in the early 1990's (CAESA 1998). This data was limited to about 50% of agricultural product sales, and only provided trend information and spatial perspective on certain products. Follow up surveys were done on a five year schedule (in 1998, 2003 and 2008), taking a more comprehensive look at pesticide sales in Alberta. Agricultural, domestic, commercial, livestock and structural sectors were surveyed (Byrtus 2000, 2007 and 2011). This information was used in the updating of pesticide monitoring programs conducted by Alberta Environment and Parks and Alberta Agriculture and Forestry. Domestic sales data was extracted to provide extensive information on pesticide use by major urban centres in Alberta, and a separate survey of domestic sales was conducted annually following the 2003 survey to inform policy decisions related to domestic pesticide regulatory actions.

For 2013, Alberta Environment and Parks undertook its fifth provincial scale review of pesticide sales; using the same data collection and reporting process as was implemented for 1998, 2003 and 2008.

The data in this overview will assist Alberta Environment and Parks and other provincial and federal agencies in comparisons of pesticide sales/usage information. It will also help to identify monitoring priorities for ongoing monitoring programs and assist in planning for new programs. It will also assist Alberta Environment and Parks in ensuring that the appropriate regulatory framework is in place for the pesticides in current use in Alberta.

The specific objectives of this project were:

1. To assemble pesticide sales records representing pesticide use for the calendar year 2013.
2. To categorize pesticide sales by active ingredient, chemical group, sector of use, and geographic distribution.

## **2.0 METHODS**

### **2.1 Sales Data**

#### **Sales Data Collection**

Alberta Environment and Parks maintains a registry of pesticide vendors that retail restricted and commercial registered pesticide products, as well as wholesale distributors of domestic class products. This registry is maintained as a component of the Environmental Management System (EMS), which tracks many of the approvals and registrations issued by Alberta Environment and Parks that fall under the *Environmental Protection and Enhancement Act (EPEA)*. The registry information is supplemented by the listing of commercial agricultural retail facilities provided by the Agrichemical Warehousing Standards Association, which are commercial retail facilities recognized under the regulations. Under the authority of this Act and its supporting regulation [Pesticide (Ministerial) Regulation], Alberta Environment and Parks can request pesticide sales records from vendors.

A letter was sent out to all registered vendors in Alberta and wholesale distributors in early 2014 requesting pesticide sales in Alberta for the calendar year 2013. Sales data was received throughout 2014 in various formats (hard copy and electronic). Records were received from approximately 93% of vendors that received sales record requests.

Hard copy records were manually entered into a standardized Excel file, while digital files were converted to the standardized spreadsheet format, which contains the vendor approval number, product registration number, quantity sold in litres or kilograms, and sector of use. Individual vendor data files were consolidated into a single sales spreadsheet, which contained over 60,000 individual sales records.

#### **Sales Data Limitations**

##### *Sector Representation*

The data from vendors that are primarily agricultural suppliers may have also contained sales to the landscape industry, the industrial vegetation management sector, municipal governments, and other non-agricultural sectors. As a result, the agricultural sector may be slightly over-represented, while the other sectors may be slightly under-represented for those products that have cross-sector utilization. Products that were sold by agricultural retailers, but that were only registered for non-cropland uses were classified as sales to the Commercial/Industrial sector.

### *Treated Seed*

Sales of fungicide and insecticide treated seed were not targeted in previous sales survey's, but these records were specifically requested for 2013. Virtually all commercial agricultural retail vendors that supplied pesticide sales data also supplied treated seed sales. As this was the first year that treated seed sales were specifically collected, there were no reference points for sales quantities or sales distribution networks.

### *Vendor List*

The vendors surveyed were based upon the list of vendors from EMS, the domestic vendors contacted annually for the domestic sales survey, along with an updated list of CropLife certified warehouses, supplied by the Agrichemical Warehouse Standards Association. Because of regulatory exemptions, not all pesticide vendors are registered under *EPEA* or under the CropLife warehouse program. For example, many of the livestock and rodenticide products have been exempted from provincial vendor registration requirements. Therefore, the livestock and rodenticide product information is not complete. Also, the sales of disinfectants, anti-microbial products and wood preservatives are exempted from requiring a vendor registration, so there is virtually no sales data on those products. In addition, products shipped directly from the registrant or from out of province distributors directly to the agricultural producer are not included in the sales data.

### *Domestic Products*

The sales records obtained from the agricultural and industrial sectors were considered reasonably accurate in terms of product sold, as they were obtained from systems reporting the point of sale for each product. On the other hand, domestic sales records came from distributors and wholesalers, as well as retail level point of sale, so there is some retail outlet based information, and some records based on sales or shipments within the province. It was assumed that the product shipped to the various domestic retail outlets in 2013 was sold in 2013. Also, some products were shipped through regional distribution systems, and some of that information was not accessed during the 2013 survey, or could only be spatially located to the provincial instead of the municipal level.

In the domestic sector, pet care products, spa and pool products, and most wood preservatives (paints and stains) sold in Alberta were not identified in this survey. Some miscellaneous household (indoor) pesticides were also missed in this survey, as they have been exempted from the provincial requirement of authorizations and sales tracking mechanisms.

### *Geographic Non-Specific Records*

Some vendors were unable to identify retail outlets for their shipments for a variety of reasons. These sales data were identified as “Alberta”, and as a result, would not be included in any geographical breakdown. These records would, however, be included in sector summaries, active ingredient listings, and chemical group summaries.

## **2.2 Pesticide Databases**

In order to consolidate pesticide formulation sales information down to active ingredient and to chemical group, two separate databases were also incorporated. The first of the pesticide databases was the pesticide Product database, which was originally obtained from the Pest Management Regulatory Agency and updated with pesticide registrations issued up to and including 2013. Registrations for fertilizer-pesticide combinations under the Fertilizer Act were also added to this database over the years, although most of these products are no longer registered. This database has information on the product registration number, active ingredient, guarantee, as well as product name, registration status, etc. This database currently has almost 20,000 records. The second pesticide database used was the Active database, which included active ingredient codes, active ingredient names, chemical family and chemical group. There are a total of 700 records in this database, which also includes disinfectants, antimicrobials and a number of historical active ingredients that used to be registered and sold in Canada.

## **2.3 Geographic Databases**

Four databases were used to identify the geographic distribution of pesticide sales information. The primary database was the Vendor database, which included the vendor registration number, along with the vendor name and location (e.g., city, town, village or hamlet). As a number of sales records were received from vendors that do not require vendor registrations in Alberta (primarily domestic retail vendors), additional vendor numbers were also generated for these. Additional vendor numbers were also generated for all municipalities in Alberta to enable geographic identification of minor vendors, or sales records to end users. Another major database was the City database, which lists all the municipalities in Alberta. Associated with each

municipality was the corresponding reference for rural municipality, drainage basin, ecodistrict and Land Use Framework region. Secondary databases included Basin (which cross-referenced drainage basin and river basins), and Natural Region (which cross-referenced ecodistrict and natural regions).

## **2.4 Data Processing**

The databases and spreadsheets were imported into Microsoft Access® (2007 and 2010) for data processing and querying. The databases were linked by related fields to calculate active ingredient values, and subsequent data groupings by chemical group, sector of use, and geographic distribution (see Cotton and Byrtus 1995 for an example of how the calculations were done). Conversion of formulated product sales to kg of active ingredient (ai) is a common means of expressing pesticide sales/use in other jurisdictions (Gregoire 1997), although actual reporting is sometimes by chemical group or by sector of use instead of by quantities of individual active ingredients.

Assumptions were made with respect to pesticide formulations, such as the specific gravity of all pesticide formulations being 1.0. In 1998, *Bacillus* formulations were assumed to be 100% active ingredient. Information on actual percentages of active ingredient on a volume basis was obtained for products sold in subsequent years, so *Bacillus* formulations are reported here as active ingredient instead of formulated product. The *Bacillus* values for 1998 included in Appendix 3 have been converted from kg of product to kg of active ingredient.

Although there were slightly over 60,000 individual sales records included in 2013, numerous products contained more than one active ingredient. The Product Database includes those multiple active ingredients for each product. The data table linkages and data processing accounts for these multiple active ingredients, and the final linked table output included almost 95,000 individual records, active ingredient specific, which were used for the data analysis by chemical group or spatial parameters.

## **2.5 Data Breakdown**

In order to simplify the analysis of the data, consolidation of the data based upon type of use, chemical group and sector of use was undertaken.

### **2.5.1 Type of Use**

Under the *Pest Control Products Act (PCP Act)*, pest control products (i.e. pesticides) are classified into 39 product types (herbicides, insecticides, fungicides, etc.) of products, which reflect their type of use. For the purpose of this document, the categories have been reduced to 6 primary types of use. All of the active ingredients identified in sales made in Alberta in 2013 are included in one of the types of use listed here. For those active ingredients that have multiple types of uses (such as thiram, which is a fungicide and a vertebrate repellent), the product is listed under its primary usage for Alberta. Sulfur products are used as fungicides and vertebrate toxicants, so that active ingredient was separated for each type of use by product. A slightly more detailed breakdown was conducted for Table 16 to align with the breakdown used by Quebec.

- Herbicides and plant growth regulators
- Insecticides, acaricides, repellents,
- Fungicides
- Vertebrate control products and vertebrate repellents
- Adjuvants/surfactants
- Other: (Soil fumigants, wood preservatives, disinfectants, anti-microbials)

The primary focus of this survey was on traditional pesticides, so anti-microbial and disinfectant pesticide sales data from industrial and domestic cleaning agents were not obtained or included, although these are also registered under the *PCP Act*. Adjuvants and surfactants are widely used in the agricultural industry in Alberta, so these records were included as a separate category.

### **2.5.2 Chemical Group**

The chemical groupings used in 2013 are based upon the groups established by the Quebec Ministry of Sustainable Development, Environment and Parks (Dion 2007), and also utilized by the Pest Management Regulatory Agency in their 2011 national pesticide sales report (PMRA 2014), in order to enable comparison between the two provincial sales reporting systems and national sales figures. The national reporting system commenced in 2008, and the latest report available during the preparation for this report was the 2011 report, the same as the Quebec reporting. As a result, Alberta sales data from 2013 was compared to 2011 data for Quebec and nationally in order to give a perspective on the different pesticide uses, but cannot be used to illustrate a direct comparison. The chemical groupings used in the Alberta report are listed in Appendix 1, along with the active ingredients included in each chemical group.

### **2.5.3 Sector of Use**

The intent of categorizing the sales by sector of use was to attempt to differentiate between various sectors and their relative usage of pesticides in Alberta. Initially, it was thought that the sales could be differentiated by product and by the vendor. For products such as home and garden pesticides (Domestic sector), and products used on livestock (Livestock sector), this was relatively easy. However, the sales records indicated that several of the vendors who sell mainly agricultural products, also sold herbicides that were registered primarily for turf, non-cropland, right of way (ROW) or landscape usage (Commercial/Industrial), and would not be used for agricultural production purposes, except perhaps for pasture renovation. These records were categorized as Commercial/Industrial.

Some products have multiple sectoral uses such as agriculture, landscaping or ROW maintenance. As the end use for these products could not be distinguished, the sales at agricultural vendors have been included under the Agricultural sector. Sales of these products at non-agricultural vendors were classified as Commercial/Industrial. The resulting breakdowns therefore, are simplified and may not accurately reflect actual sectoral usage in Alberta. Some general guidance on sectoral usage was provided by the use patterns identified in the Alberta Agriculture and Rural Development publication “Crop Protection 2013” (AARD 2013).

The use sectors used in this report include:

- Agricultural (products sold at agricultural outlets and that are registered for on-farm use)
- Domestic (products shipped to or sold at garden centres, hardware stores, etc)
- Commercial/Industrial (includes forestry, ROW, landscaping, golf courses, municipal & structural, or multiple use products sold through non-agricultural vendors)
- Livestock (products sold for use on cattle, horses, sheep, etc)

The structural sector was previously reported as a separate sector, but was included in the Commercial/Industrial sector in 2008 and 2013.

### **2.5.4 Geographic Units**

#### **2.5.4.1 River Basins**

There are 13 major river basins located within Alberta. Within these river basins are numerous sub-basins or drainage basins, which define the watersheds of major and minor tributaries. In



order to assist the interpretation of pesticide monitoring data for Alberta, which is generally reported by major river basin, and sometimes by sub-basin, identification of overall pesticide usage by river basin was required. All of the municipalities in the City database were identified as to their respective sub-basin. The major river basins in Alberta used for this report are based upon Prairie Farm Rehabilitation Administration basins, obtained from Alberta Agriculture and Food (Spiess 2005):

- Athabasca River
- Battle River
- Beaver River
- Bow River
- Hay River
- Milk River
- North Saskatchewan River
- Oldman River
- Peace River
- Red Deer River
- Sounding Creek
- South Saskatchewan River

#### **2.5.4.2 Natural Regions**

There are six major natural regions in Alberta, which contain a total of 21 subregions. To link pesticide sales to the various natural regions in Alberta, each municipality in the City database was allocated to an ecodistrict, which was then linked to the respective natural region in the Natural Region database. The detailed maps used to determine municipality location in relation to ecodistrict were obtained from Alberta Agriculture, Food and Rural Development (AAFRD 2003) and Strong and Thompson (1995). The natural regions identify different ecological zones within Alberta, which are influenced by soil type, climate, physiography, water, fauna, land use, and vegetative cover (Ecological Stratification Working Group 1995). The natural regions of Alberta (updated in 2005) are:

- Grassland
- Parkland
- Canadian Shield
- Foothills
- Rocky Mountain
- Boreal Forest

#### **2.5.4.3 Land Use Framework**

The Government of Alberta initiated a new program in 2006 to develop a provincial land use planning blueprint to better manage public and private lands and natural resources to achieve Alberta's long term goals (Land Use Secretariat 2008). The Land Use Framework is intended to balance economic, social and environmental interests competing to utilize the same land base. The provincial framework is broken down into seven regional planning areas, which are aligned

by river basins at a broad scale, and by municipal boundaries at the fine scale. The seven planning areas are:

- Lower Athabasca
- Upper Athabasca
- Lower Peace
- Upper Peace
- North Saskatchewan
- Red Deer
- South Saskatchewan

Further work is being undertaken to develop and implement sub-regional plans, but the spatial boundaries for the sub-regional plans are not yet established.

#### **2.5.4.4 Municipalities**

There are about 88 municipalities (rural municipalities, cities and national parks) in Alberta. Pesticide sales were allocated to the municipality in which the vendor was located for data analysis by geo-political boundaries. In most situations, agricultural sales made at a vendor located in a city were consolidated to the surrounding rural municipality (e.g., Camrose) for the purposes of sub-regional assessments and mapping purposes. The cities of Calgary and Edmonton were identified as distinct municipalities for this report.

## **2.6 Use Intensity**

Pesticide use intensity (kg of active ingredient used per hectare of land) is an inexact measurement, but it is often used to compare relative pesticide use between regions or countries with different land areas, or areas with different pesticide usage as a result of different crops requiring different pesticide inputs. It can also be used as a measure of relative pesticide use over time. In this report, pesticide sales by defined geographic area were considered representative of use, and the use intensity was calculated based on the land base for the defined geographic area. Use intensity was calculated based only on agricultural pesticide sales (excluding adjuvants), and area of cropland for the province and for selected municipalities based on 2011 agricultural census data collected by Statistics Canada, and broken down by municipality by Alberta Agriculture and Rural Development (2014).

### 3.0 RESULTS

In 2013, a total of 15 231 071.5 kg of active ingredient was sold in Alberta. The sales data are broken down as follows.

#### 3.1 Type of Use

Herbicides and plant growth regulators (PGR's) made up the majority of pesticides sold in Alberta, at 86.7% (Table 1). The majority of the increase in sales between 2008 and 2013 was attributed to the increase in sales of herbicides and to a lesser extent, the increase in fungicide sales.

Fungicides made up a much smaller proportion of sales (slightly over 5.3%), while insecticides made up only slightly more than 1% of sales. Compared to 2003, when insecticides made up a much larger proportion of sales as a result of a grasshopper outbreak that year, 2013 insecticide sales were relatively low, even though insecticides incorporated on treated seeds were included in 2013 sales reporting.

**Table 1. Pesticide Sales by Type of Use**

Type of Use	2013 kg ai	2013 %	2008 kg ai	2008 (%)	2003 kg ai	2003 %
Herbicides, PGR's	13 200 340.0	86.7	10 257 303.0	82.2	7 158 660.3	77.3
Insecticides, Acaracides, Repellents	200 571.5	1.3	236 168.7	1.9	433 176.1	4.7
Fungicides	807 882.6	5.3	388 560.4	3.1	319 464.5	3.4
Vertebrate Control Products and Vertebrate Repellents	11 334.1	0.07	12 458.4	0.1	1 712.9	0.02
Adjuvants and Surfactants	1 010 264.9	6.6	1 580 103.8	12.7	1 350 159.8	14.6
Other	678.4	0.004	1 501.4	0.01	1 313.9	0.01
<b>Total</b>	<b>15 231 071.5</b>	<b>100</b>	<b>12 476 095.8</b>	<b>100</b>	<b>9 264 487.7</b>	<b>100</b>

Vertebrate control products and repellents made up a very small percentage of pesticide sales, at less than 0.1%. This was made up predominantly (almost 9,600 kg) of a newer domestic class product used for mouse control (cellulose from powdered corn cobs), compared to 2008 when sulfur was the dominant vertebrate control product (11 404.8 kg ai).

Adjuvants and surfactants made up the second largest group, in terms of percentage of sales. These compounds are used to enhance the effectiveness of the herbicides on the target weed(s).

They have been categorized as a separate type of use, but because they are virtually always used in conjunction with a herbicide, they could be considered a component of the Herbicide group.

The adjuvants used to be co-packaged with the herbicides that required their use. However, some situations and applications did not require the full volume of (or any) adjuvant, and issues with leftover adjuvant disposal led to changes in packaging to decouple the adjuvant from the herbicide. Even with the decoupling (implemented after the 2003 sales reporting), adjuvant sales have remained high, as a result of continued need and increased herbicide usage.

The “Other” category includes sales for products that do not fit the named categories, and for which only a limited number of sales records were received. This category includes wood preservatives, disinfectants, slimicides and soil fumigants. As the disinfectants and slimicides are exempted under the provincial pesticide regulations, and the focus of the sales survey was primarily on the traditional pesticides, very little information on these products was obtained.

### 3.2 Chemical Group

The sales records were also broken down by chemical group (Table 2), as outlined in Appendix 1. The active ingredients included in the chemical groups were aligned with the Quebec Ministry of Sustainable Development, Environment and Parks listings (Dion 2007), and the PMRA reporting (PMRA 2014) to enable provincial and national comparisons of sales data (Appendix 2).

The chemical group with the largest proportion of sales was the Phosphonic Acids, Phosphinic Acids group at 61.9 % (up from 53.2% in 2008 and from 38.1% in 2003), followed by the Phenoxy Acids at 10.8% (down from 17.1% in 2008). The next group was the Fatty Acids & Surfactants at 4.97% range. The remaining chemical groups were all under 5%, and 42 of the 54 chemical groups were under 1% of total sales.

**Table 2. Summary of Pesticide Sales by Chemical Group (all sectors)**

<b>Chemical Grouping</b>	<b>2013 kg ai</b>	<b>2013 %</b>	<b>2008 kg ai</b>	<b>2008 %</b>
Phosphonic Acids, Phosphinic Acids	9 424 536.7	61.9	6 633 567.6	53.2
Phenoxy Acids	1 639 505.7	10.8	2 130 654.7	17.1
Fatty Acids & Surfactants	741 830.4	4.9	924 680.7	7.4
Triazoles	414 769.8	2.7	104 706.9	0.8
Benzonitriles	381 607.4	2.5	366 443.3	2.9
Carbamates	379 681.2	2.5	127 842.3	1.0
Miscellaneous (Non-Classified)	356 703.9	2.3	18 881.7	0.2
Halogenated Organic Acids	256 044.6	1.7	88 074.6	0.7

<b>Chemical Grouping</b>	<b>2013 kg ai</b>	<b>2013 %</b>	<b>2008 kg ai</b>	<b>2008 %</b>
Hydrocarbons	218 049.6	1.4	659 521.1	5.3
Acyureas	189 398.9	1.2	85 612.4	0.7
Azoles, Oxazoles, Thiazoles	122 374.8	0.8	41 280.5	0.3
Dinitrobenzenes	113 793.5	0.7	118 607.6	1
Methoxyacrylates	100 570.3	0.7	20 532.1	0.2
Guanidines	99 906.6	0.7	6 849.5	0.05
Cyclohexanedione oximes	95 701.1	0.6	191 948.1	1.5
Aryloxyphenoxyl Acids	95 469.8	0.6	110 792.2	0.9
Anilides, Anilines	80 816.9	0.5	26 918.2	0.2
Ammoniums, Quaternary	68 066.1	0.4	40 722.8	0.3
Alcohols	56 198.2	0.4	5 853.1	0.05
Benzoic Acid & Derivatives	55 629.0	0.4	94 908.1	0.8
Imidazolinones	45 553.6	0.3	111 806.9	0.9
Inorganics, Other	40 399.3	0.3	64 911.7	0.5
Sulfonylureas	40 314.2	0.3	27 844.2	0.2
Thiophosphates	37 513.1	0.2	85 271.0	0.7
Biscarbamates	36 060.7	0.2	102 813.6	0.8
Urea Derivatives	27 134.3	0.2	47 686.2	0.4
Dithiophosphates	24 009.4	0.2	57 202.3	0.5
Morpholines & Oxathiines	19 122.4	0.1	15 453.0	0.12
Oils, Mineral and Vegetable	11 839.8	0.1	3 925.8	0.03
Triazines, Tetrazines	10 956.2	0.1	16872.6	0.14
Pyrethroids, Pyrethrins	10 031.9	0.1	5 717.9	0.05
Amides	7 713.3	0.1	270.9	0
Benzamides	6 959.8	0.05	1 694.3	0.01
Inorganic Coppers	6 937.6	0.05	4 141.5	0.03
Organic Acids	5 734.9	0.04	12 048.4	0.1
Nitrobenzenes	2 655.5	0.02	7 627.0	0.06
Microbials	2 488.4	0.02	420.4	0
Pyridines	2 263.1	0.01	72 411.4	0.6
Phosphates	787.2	0.01	1 077.6	0.01
Diazines	691.0	0	1 291.1	0.01
Phthalic Acids	458.1	0	27 137.5	0.2
Organochlorines	450.3	0	830.3	0.01
Inorganic Zincs	146.1	0	179.8	0
Phosphoramidothioates	83.0	0	626.2	0.01
Aldehydes	48.9	0	569.4	0
Complex Mixture	24.0	0	0	
Chromenones	13.2	0	61.9	0
Organometallics	12.0	0	8.6	0
Others	10.0	0	0	
Pheremones	2.8	0	1 274.0	0.01
Indanediones	2.1	0	24.6	0
Phenols	1.3	0	0	
Organohalogens	0	0	6 106.3	0.05
Dithiocarbamates	0	0	392	0
<b>Total</b>	<b>15 231 071.5</b>	<b>100</b>	<b>12 476 095.8</b>	<b>100</b>

### 3.3 Sector of Use

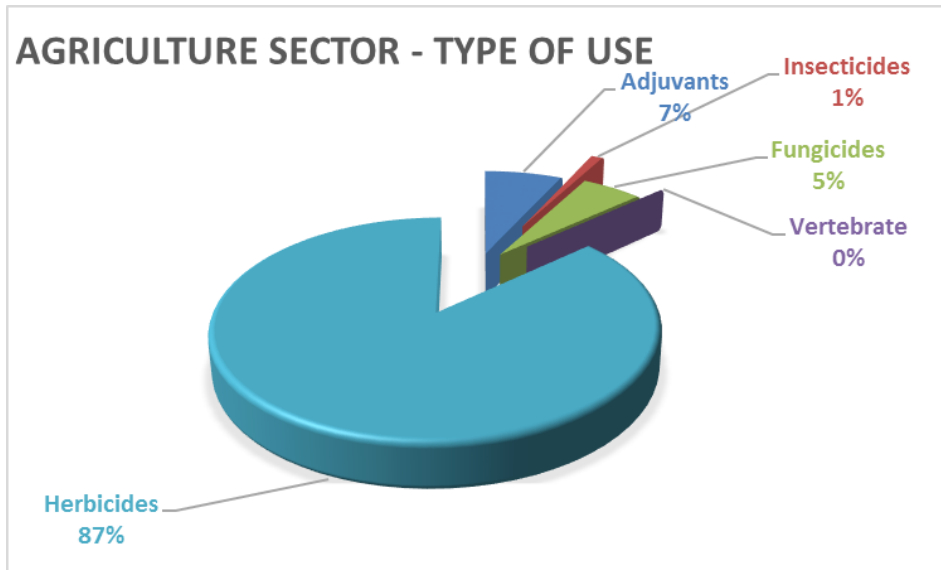
Pesticide sales broken down by sector of use are listed in Table 3. As expected, agricultural use dominates pesticide sales in Alberta at 95.3%. The next sector was the Domestic Sector at 2.7%. The Commercial/Industrial sector comprised 2.0% of provincial pesticide sales. The Livestock sector made up less than 0.1% of all sales. The sectoral breakdowns were slightly different than the 2003 results, with the growth in the domestic sector sales being the primary change. Further breakdown of the sector sales by type of use was conducted to assess if the overall trends in type of use was consistent within each sector. Figures 1-3 show the breakdowns for each sector.

**Table 3. Pesticide Sales by Sector**

Sector	2013 kg ai	2013 %	2008 kg ai	2008 %
Agriculture	14 515 027.8	95.3	11 985 047.9	96.1
Commercial/Industrial	299 775.2	2.0	388 537.0	3.1
Domestic	414 717.9	2.7	89 533.6	0.7
Livestock	1 550.6	0.0	12 977.3	0.1
Grand Total	<b>15 231 071.5</b>	<b>100</b>	<b>12 476 095.8</b>	<b>100</b>

#### 3.3.1 Agricultural Sector

Herbicides made up the majority of pesticide use in the agricultural sector, with 87% of all sales. Adjuvants were the next highest category, at over 7% of pesticide use. Adjuvants and surfactants are widely used to enhance the application and effectiveness of herbicides. Fungicide use was the next category at 5%, a figure that had grown from under 3% in 2008. Insecticide sales were 1% of agricultural pesticide sales in Alberta.



**Figure 1. Agriculture Sector – Type of Use**

The top 15 active ingredients sold in the agricultural market in Alberta in 2013 are listed in Table 4, with comparisons to the agricultural sales of those active ingredients in 2008, 2003 and 1998. Overall, there was little change in the order of the top selling products, although some changes were observed as a result of changes in agronomic practices or product replacements. Substantial increases (>20%) were observed for glyphosate, glufosinate and triallate. Glyphosate sales increased 41%, while glufosinate sales increased by 76% and triallate increased by 263% over 2008 volumes.

Both 2,4-D and MCPA had reductions of sales from 2008, but were still in the top four of Alberta sales. Large increases in sales of tebuconazole and bentazon were also observed (>400%).

No insecticides were in the top 15 of pesticide sales.

**Table 4. Top 15 Agricultural Active Ingredients Sold in 2013, 2008, 2003 and 1998**

Active Ingredient	Usage	2013 Sales (kg ai)	2008 Sales (kg ai)	2003 Sales (kg ai)	1998 Sales (kg ai)	% Change (2008 to 2013)
Glyphosate	Herbicide	8 667 958.8	6 125 309.7	3 333 994.5	2 627 599.3	+41.5%
MCPA	Herbicide	920 011.3	1 028 115.8	1 096 848.9	884 937.5	-10.5%
Glufosinate	Herbicide	694 347.4	394 652.8	106 689.6	63 400.8	+75.9%
2,4-D	Herbicide	565 725.7	840 464.6	685 294.5	674 902.6	-32.7%
Triallate	Herbicide	367 416.9	101 072.2	197 221.4	693 269.3	+263.5%
Bromoxynil	Herbicide	315 620.6	330 177.1	354 906.6	268 105.3	-4.4%
Surfactant Blend	Adjuvant	299 027.9	401 107.1	437 400.5	496 177.7	-25.4%
Petroleum Hydrocarbon Blend	Adjuvant	215 138.9	656 588.2	559 728.7	368 704.3	-67.2%
Fluroxypyr	Herbicide	156 865.7	71 814.1	43 166.7	23 700.7	+118.4%
Methylated Canola Oil	Adjuvant	134 649.3	187 385.6	0	0	-28.1%
Tebuconazole	Fungicide	121 566.7	15 549.0	5 922.4	0	+681.8%
Bentazon	Herbicide	117 357.2	20 481.0	21 986.9	12 066.2	+473.0%
Propiconazole	Fungicide	117 177.2	49776.9	12 861.9	5 549.6	+135.4%
Paraffin Base Mineral Oil	Adjuvant	107 960.9	188 738.7	192 634.4	192 708.2	-42.8%
Polyoxyalkylated alkyl phosphate ester	Adjuvant	97 257.9	55943.9	13 727.8	9 340.0	+73.8%

In order to better compare the sector sales to sales information from Quebec and nationally, the chemical group breakdown was conducted on the agricultural pesticide sales (Table 5). The chemical group breakdown was changed significantly to align with the Quebec system (Dion 2007) just prior to the 2008 report, and as a result, there are no comparisons for most chemical groups for 2003.

The Phosphonic/Phosphinic Acids group dominated the Alberta agricultural sales at over 64%. Although the Phenoxy Acids group dropped in overall and proportional sales in 2014, it still accounted for over 10% of sales. The surfactants (Fatty Acids and Surfactants) decreased in sales from 2008. The Triazoles increased by over 4 times from 2008, but still only accounted for 2.8% of agricultural sales, while the Carbamates tripled in sales. Conversely, the Hydrocarbons dropped to a third of the 2008 sales, reflecting a large drop in adjuvant sales within this group. The remaining groups comprised less than 3% or less individually, or slightly over 16% combined.

**Table 5. Summary of Agricultural Pesticide Sales by Chemical Group**

Chemical Group	2013		2008	
	Kg ai	%	Kg ai	%
Phosphonic Acids, Phosphinic Acids	9 365 183.8	64.5	6 522 273.7	54.4
Phenoxy Acids	1 518 462.3	10.5	1 938 624.1	16.2
Fatty Acids & Surfactants	718 811.3	5.0	918 522.1	7.7
Triazoles	412 181.6	2.8	100 015.6	0.8
Carbamates*	376 115.1	2.6	120 131.1	1.0
Benzonitriles	364 772.3	2.5	362 733.9	3.0
Halogenated Organic Acids	233 932.9	1.6	68 986.3	0.6
Hydrocarbons	215 138.9	1.5	656 588.2	5.5
Acylureas	181 360.4	1.2	81 590.3	0.7
Azoles, Oxazoles, Thiazoles	121 846.5	0.8	41 210.3	0.3
Dinitrobenzenes	113 788.7	0.8	118 607.6	1.0
Methoxyacrylates	100 153.9	0.7	20 243.1	0.2
Guanidines	99 752.1	0.7	6 770.1	0.06
Cyclohexanedione oximes	95 701.1	0.7	191 948.1	1.6
Aryloxyphenoxy Acids	95 467.8	0.7	110 792.2	0.9
Anilides, Anilines	80 357.1	0.6	26 870.7	0.2
Ammoniums, Quaternary	67 320.5	0.5	40 464.0	0.3
Alcohols	55 385.8	0.4	0.0	0.0
Imidazolinones	40 469.8	0.3	108 067.7	0.9
Benzoic Acid & Derivatives	39 556.3	0.3	78 065.3	0.7
Sulfonylureas	39 261.8	0.3	27 585.8	0.2
Thiophosphates	37 430.3	0.3	85 072.1	0.7
Biscarbamates	35 719.8	0.2	99 910.8	0.8
Inorganics, Other	21 165.6	0.1	46 177.8	0.4
Dithiophosphates	19 393.6	0.1	50 761.6	0.4
Morpholines & Oxathiines	19 119.5	0.1	14 366.9	0.1
Triazines, Tetrazines	9 026.2	0.06	5 916.6	0.05
Pyrethroids, Pyrethrins	8 268.1	0.06	3 479.7	0.03
Amides	7 571.7	0.05	121.3	0.001
Inorganic Coppers	6 307.2	0.04	3 407.7	0.03
Urea Derivatives	4 995.4	0.03	15 969.3	0.1
Nitrobenzenes	2 655.5	0.02	76.6	0
Pyridines	2 209.8	0.02	72 222.2	0.6



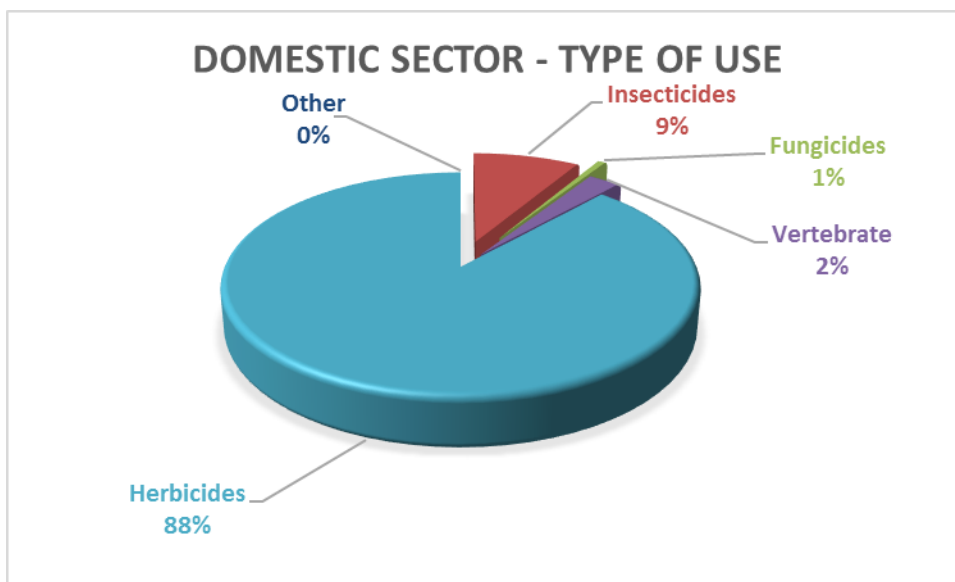
Miscellaneous (Non-Classified)	2 085.2	0.01	6 834.3	0.06
Benzamides	983.9	0.007	397.5	0.003
Microbials	903.0	0.006	124.1	0.001
Diazines	680.9	0.005	940.1	0.008
Phosphates	568.3	0.004	809.9	0.007
Organic Acids	458.0	0.003	5.0	0
Organochlorines	324.0	0.002	256.5	0.002
Phthalic Acids	109.2	0.001	26 841.1	0.2
Phosphoramidothioates	27.0	0	415.7	0.003
Oils, Mineral & Vegetable	4.7	0	0	0
Chromenones	0.6	0	6.8	0
Pheromones	0.4	0		
Indanediones	0.2	0	1.8	0
Chlorotriazines**	0	0	10 785.3	0.09
Oximes-Carbamates	0	0	24.3	0
Inorganic Zincs	0	0	23.6	0
Aldehydes	0	0	8.9	0
<b>Total</b>	<b>14 515 027.8</b>	<b>100</b>	<b>11 985 047.9</b>	<b>100</b>

\* Carbamates group now include the active ingredients EPTC and triallate, which were grouped as Thiocarbamates in 2008.

\*\*Chlorotriazines group included atrazine, pymetrozine and simazine in 2008. Those compounds were included in the Triazines, Tetrazines group in 2013. All 2008 chemical group data included in this report has been aligned with this consolidation.

### 3.3.2 Domestic Sector

In the domestic sector (Figure 2), herbicides again dominated at 88%, up from 68% in 2008, while insecticide sales dropped to 9% from 27% in 2008. The large increase in herbicides results from the inclusion of a new weed germination inhibitor product on the market, corn gluten meal, which has been used by some homeowners as a replacement for the weed and feed herbicides. This product is 99-100% active ingredient, compared to the weed and feed products that had only 1-2% active ingredient. As with the insecticides, fungicide sales also went down as a proportion of total domestic sales, while vertebrate products increased as a result of another new product with a high active ingredient guarantee (cellulose from powdered corn cobs).



**Figure 2. Domestic Sector – Type of Use**

As with the agricultural products, the domestic product sales were also broken down by chemical group (Table 6). In the Domestic sector, the Miscellaneous dominated at almost 83% of total domestic pesticide sales, followed by Inorganics and Phosphonic/Phosphinic Acids. These three groups combined made up over 90% of all domestic sales. The Phenoxy Acids group dropped considerably in sales, mainly as a result of the weed and feed products being no longer available. The Miscellaneous group is dominated (96%) by the corn products (corn gluten meal, liquid corn gluten, cellulose from powdered corn cob). These products are derived from natural ingredients, and have high active ingredient guarantees (up to 100%). As a result, direct comparison of substitutions for lawn herbicides is not possible. Trends in individual chemical groups can be followed over time.

**Table 6. Summary of Domestic Pesticide Sales by Chemical Group – 2008 & 2013**

Chemical Group	2013 kg ai	%	2008 kg ai	%
Miscellaneous (Non-Classified)	343 905.8	82.9	1 604.6	1.8
Inorganics, Other	18 506.4	4.5	16 388.0	18.3
Phosphonic Acids, Phosphinic Acids	12 917.0	3.1	12 195.8	13.6
Phenoxy Acids	11 684.0	2.8	37 194.2	41.5
Benzamides	5 711.9	1.4	1 201.7	1.3
Organic Acids	5 081.5	1.2	1 843.7	2.1
Dithiophosphates	3 080.8	0.7	3 138.0	3.5
Hydrocarbons	2 903.0	0.7	2 932.9	3.3
Oils, Mineral and Vegetable	2 899.9	0.7	1 729.5	1.9
Carbamates	2 745.2	0.7	5 451.6	6.1
Fatty Acids & Surfactants	2 213.8	0.5	2 241.5	2.5

Pyrethroids, Pyrethrins	906.2	0.2	576.0	0.6
Benzoic Acid & Derivatives	628.7	0.2	904.7	1.0
Inorganic Coppers	581.6	0.1	593.3	0.7
Phthalic Acids	286.9	0.07	211.6	0.2
Phosphates	189.0	0.05	112.6	0.1
Inorganic Zincs	146.1	0.04	153.5	0.2
Organochlorines	122.3	0.03	510.3	0.6
Biscarbamates	90.0	0.02	223.7	0.2
Aldehydes	48.9	0.01	104.5	0.1
Alcohols	39.5	0.01	1.3	0.0
Microbials	13.7	0.0	3.8	0.0
Chromenones	12.4	0.0	34.9	0.04
Amides	1.6	0.0	1.2	0.0
Phenols	1.3	0.0	0	0
Indanediones	0.2	0.0	0.8	0.0
Thiophosphates	0.1	0.0	0.009	0.0
Diazines	0.1	0.0	0.4	0.0
Azoles, Oxazoles, Thiazoles	0.02	0.0	0.03	0.0
Chlorotriazines	0	0	134.2	0.1
Triazoles	0	0	44.7	0.05
Pheromones	0	0	0.2	0.0
Ammoniums, Quaternary	0	0	0.15	0.0
<b>Total</b>	<b>414 717.9</b>	<b>100</b>	<b>89 533.6</b>	<b>100.0</b>

The top domestic active ingredients sold in 2013 are listed in Table 7. The recently registered active ingredients (corn gluten meal and liquid corn gluten) were not sold in Alberta in 2008, but by 2013 accounted for over 330 000 kg of active ingredient. Silicon dioxide (salt water fossils, or diatomaceous earth) sales doubled in sales from 2008, as products containing this active ingredient continued to be more widely utilized for insect control in indoor situations.

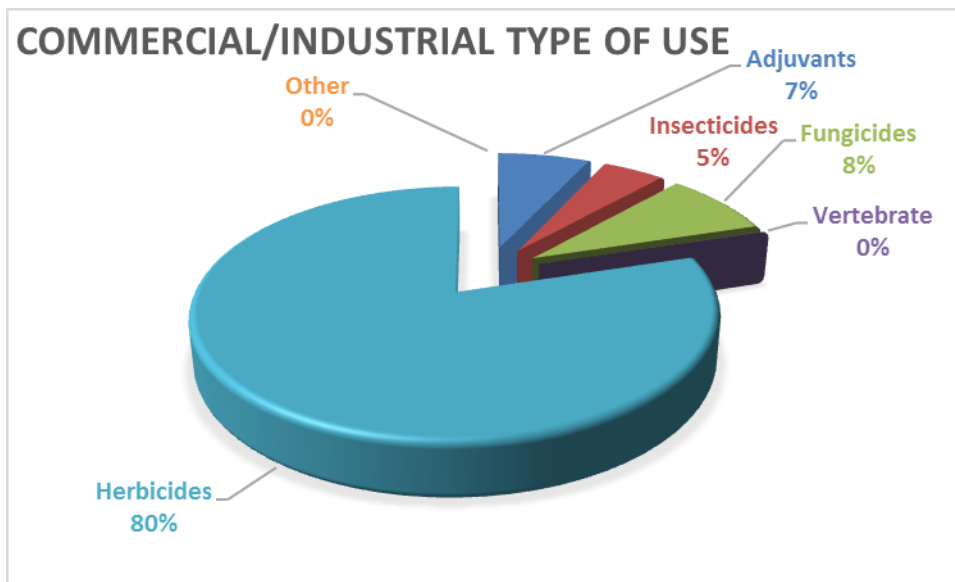
Glyphosate sales have remained constant over the past 10 years, even though similar total vegetation control active ingredients like acetic acid have increased in sales in recent years, and older total vegetation control active ingredients have come off the market. Another new active ingredient that has come onto the market since 2008 is cellulose from powdered corn cob, which is used as a mouse control product. The top selling active ingredient in 2008 was 2, 4-D, but sales have dropped by two thirds by 2013.

**Table 7. Top 15 Domestic Active Ingredients Sold in 2013, 2008, 2003 and 1998**

Domestic active ingredient	2013 kg ai	2008 Kg ai	2003 kg ai	1998 kg ai
Corn Gluten Meal	330 967.4	0.0	0.0	0.0
Silicon dioxide salt water fossils	14 035.8	6 666.6	7 509.2	2 962.7
Glyphosate	12 768.3	11 167.6	10 448.5	6 099.4
Cellulose from powdered corn cob	9 596.9	0.0	0.0	0.0
2,4-D	7 989.9	25 107.2	14 392.5	22 505.1
DEET	5 711.9	1 201.7	3 413.3	3 972.2
Acetic Acid	4 984.2	1 815.5	1 130.5	0.0
Mecoprop	3 694.2	12 087.0	6 273.8	9 313.6
Malathion	3 080.0	3 116.7	1 667.8	2 655.6
Mineral Oil (Insecticidal)	2 884.2	1 701.4	838.9	2 986.9
Carbaryl	2 719.0	5 433.4	3 151.9	1 292.2
Naphthalene	2 449.3	2 318.2	118.5	1 371.6
Liquid Corn Gluten	2 246.8	0.0	0.0	0.0
Iron FeHDTA	1 327.6	0.0	0.0	0.0
Sulfur (fungicide)	1 021.5	943.2	722.8	957.5

### 3.3.3 Commercial/Industrial Sector

In the Commercial/Industrial Sector, herbicides again dominated at 80% of pesticide sales (Figure 3). Insecticides made up over 5%. Fungicide sales were proportionately slightly higher in this sector at 8%, a reflection of fungicide sales to the golf course and horticultural industries. Table 8 provides a more detailed breakdown of the top 15 active ingredients that were classified as being sold and used in the commercial/industrial sectors, and reflects the dominance of active ingredients sold and used for industrial site and right-of-way maintenance



**Figure 3. Commercial/Industrial Sector – Type of Use**

**Table 8. Top 15 Commercial/Industrial Active Ingredients Sold in 2013 2008, 2003 and 1998**

<b>Commercial/Industrial Active Ingredient</b>	<b>2013 kg ai</b>	<b>2008 kg ai</b>	<b>2003 kg ai</b>	<b>1998 kg ai</b>
2,4-D	67 455.4	107 510.5	63 670.6	68 412.7
Glyphosate	46 176.9	99 021.2	75 379.1	49 050.2
Triclopyr	32 690.4	23 932.8	29 625.6	29 908.8
Diuron	21 636.1	31 707.3	28 960.0	9 627.5
Octadec-9-enoic acid, methyl ester	18 097.2	0.0	0.0	0.0
Chlorothalonil	16 756.4	3 605.0	4 363.5	6 768.3
Dicamba	15 443.9	15 931.9	12 344.2	18 849.5
Picloram	10 962.7	14 574.7	13 302.3	14 633.6
Acrolein	10 367.9	9 051.0	16 981.4	17 520.5
Aminopyralid	9 086.5	3 539.6	0.0	0.0
Mineral Oil (Insecticide)	8 935.2	2 196.3	1 394.8	474.7
Mecoprop	7 996.0	19 933.7	12 288.0	10 991.2
Imazapyr	5 083.8	3 739.2	1 675.8	200.6
Iprodione	4 079.4	2 381.8	2 109.9	4 651.0
Bromacil	3 957.4	1 626.9	3 051.6	1 949.7

The Commercial/Industrial sector sales were also broken down by chemical group (Table 9). In this sector, the Phenoxy Acids were the largest group by sales, with the Phosphonic/Phosphinic Acids following. These two groups of herbicides made up over 52% of total sales in this sector, reflecting the predominance of the industrial facility maintenance and commercial landscape industries in this sector.

**Table 9. Summary of Commercial/Industrial Pesticide Sales by Chemical Group – 2013 & 2008**

<b>Chemical Group</b>	<b>2013 kg ai</b>	<b>%</b>	<b>2008 kg ai</b>	<b>%</b>
Phenoxy Acids	109 359.4	36.5	154 836.4	39.9
Phosphonic Acids, Phosphinic Acids	46 435.9	15.5	99 098.0	25.5
Urea Derivatives	22 138.9	7.4	31 716.9	8.2
Halogenated Organic Acids	22 111.7	7.4	19 088.3	4.9
Fatty Acids & Surfactants	20 805.3	6.9	3 917.1	1.0
Benzonitriles	16 835.0	5.6	3 709.4	1.0
Benzoic Acid & Derivatives	15 443.9	5.2	15 938.2	4.1
Miscellaneous (Non-Classified)	10 428.1	3.5	9 139.3	2.4
Oils, Mineral and Vegetable	8 935.2	3.0	2 196.3	0.6
Acylureas	8 038.6	2.7	4 022.2	1.0
Imidazolinones	5 083.8	1.7	3 739.2	1.0
Triazoles	2 588.2	0.9	4 646.5	1.2
Triazines, Tetrazines	1 930.0	0.6	2.7	0.0
Microbials	1 571.7	0.5	292.5	0.1

Dithiophosphates	1 126.9	0.4	421.9	0.1
Sulfonylureas	1 052.4	0.4	258.3	0.1
Inorganics, Other	727.2	0.2	1 031.9	0.3
Ammoniums, Quaternary	665.6	0.2	258.7	0.1
Alcohols	662.7	0.2	1 690.2	0.4
Pyrethroids, Pyrethrins	561.1	0.2	456.2	0.1
Azoles, Oxazoles, Thiazoles	528.3	0.2	70.1	0.02
Carbamates	472.0	0.2	1 399.8	0.4
Anilides, Anilines	459.8	0.2	47.5	0.01
Methoxyacrylates	416.5	0.1	289.0	0.1
Benzamides	264.1	0.1	94.9	0.02
Biscarbamates	250.8	0.1	2 679.0	0.7
Organic Acids	195.5	0.1	10 199.7	2.6
Guanidines	154.5	0.1	79.3	0.02
Amides	140.0	0.05	148.4	0.04
Thiophosphates	80.1	0.03	195.4	0.1
Phosphoramidothioates	56.0	0.02	210.5	0.1
Phthalic Acids	53.5	0.02	72.0	0.02
Inorganic Coppers	48.8	0.02	140.5	0.04
Pyridines	43.5	0.01	44.3	0.01
Phosphates	29.0	0.01	155.1	0.04
Complex Mixture	24.0	0.01	0	0
Organometallics	12.0	0.0	8.6	0.0
Diazines	10.0	0.0	350.6	0.1
Others	10.0	0.0	0	0
Hydrocarbons	7.7	0.0	0	0
Dinitrobenzenes	4.8	0.0	0.00004	0.0
Organochlorines	4.0	0.0	63.5	0.02
Morpholines & Oxathiines	2.9	0.0	1 086.1	0.3
Aryloxyphenoxy Acids	2.0	0.0	0	0
Pheremones	1.8	0.0	176.5	0.05
Indanediones	1.7	0.0	22.1	0.01
Chromenones	0.2	0.0	0.5	0.0
Nitrobenzenes	0	0	7 550.4	1.9
Organohalogens	0	0	6 106.3	1.6
Aldehydes	0	0	456.0	0.1
Dithiocarbamates	0	0	392.0	0.1
Chlorotriazines	0	0	33.8	0.01
Inorganic Zincs	0	0	2.7	0.0
Oximes-Carbamates	0	0	2.4	0.0
<b>Total</b>	<b>299 775.2</b>	<b>100.0</b>	<b>388 537.0</b>	<b>100.0</b>

### 3.3.4 Other Sectors

Pesticide sales in the Livestock sector consisted of primarily repellents or insecticides, used for direct application to livestock or as space sprays or repellents in the buildings used for sheltering livestock. The top four active ingredients by sales (with sector sales percentages and specific

uses) were malathion (22% - insecticide), carbaryl (22% - insecticide), piperonyl butoxide (18.3% - synergist used with pyrethrins), and permethrin (15.4% - insecticide).

### 3.4 Geographic Distributions

#### 3.4.1 Drainage Basin

##### 3.4.1.1 Agricultural Usage

Sales of all agricultural pesticides (excluding adjuvants) were broken down by drainage basin (Table 10 and Figure 4). The North Saskatchewan River basin had the highest proportion of agricultural pesticide sales, at almost 17%, followed by the Battle River, the Red Deer River and the Oldman River basins. The Peace River basin also had over 12% of total agricultural pesticide sales, while the South Saskatchewan River had almost 11%, while the remaining basins were all below 10%.

**Table 10. Agricultural Pesticide Sales (excluding adjuvants) by River Basin**

River Basin	2013		2008		2003	
	kg ai	%	kg ai	(%)	kg ai	(%)
North Saskatchewan River	2 409 680.1	16.6	1 393 229.6	13.4	1 137 851.8	15.0
Battle River	2 301 057.1	15.9	1 544 739.9	14.8	1 108 136.4	14.6
Red Deer River	2 208 033.3	15.2	1 770 580.7	17.0	1 334 005.1	17.6
Oldman River	2 041 522.1	14.1	2 068 309.6	19.9	1 615 182.5	21.4
Peace River	1 760 903.0	12.1	1 202 936.2	11.6	731 480.1	9.7
South Saskatchewan River	1 556 633.7	10.7	872 798.3	8.4	647 561.2	8.6
Bow River	809 930.9	5.6	825 266.5	7.9	536 221.4	7.1
Athabasca River	547 991.3	3.8	360 375.6	3.5	234 328.2	3.1
Sounding Creek	288 739.2	2.0	213 163.7	2.0	113 392.8	1.5
Milk River	76 182.7	0.5	79 640.0	0.8	34 858.4	0.5
Beaver River	98 346.7	0.7	77 237.5	0.7	64 767.2	0.9
Non-specific basin	416 007.7	2.9	1 368.5	0.0	4 069.1	0.05
<b>Total</b>	<b>14 515 027.8</b>	<b>100</b>	<b>10 409 646.5</b>	<b>100</b>	<b>7 561 853.9</b>	<b>100</b>

##### 3.4.1.2 Domestic Pesticide Sales by River Basin

Sales of domestic active ingredients were also broken down by river basin (Table 11). In this category, sales by river are influenced by the two major population centres in Alberta and their metropolitan areas: Calgary and Edmonton. The North Saskatchewan and Bow River basins had the largest sales by basin, followed by the Red Deer River and Athabasca River basins. All basins (except for the Sounding Creek, Milk River and Hay River basins) increased in sales volumes from 2008. The increase for all basins is related to the corn gluten product sales that came onto the market between 2008 and 2013.

**Table 11. Total Domestic Pesticide Sales by River Basin**

<b>River Basin</b>	<b>2013 kg ai</b>	<b>2008 kg ai</b>	<b>2003 kg ai</b>
North Saskatchewan	139 659.6	26 095.2	10 248.9
Bow River	124 567.4	20 276.6	10 652.4
Red Deer River	30 942.9	7 208.1	3 710.2
Athabasca River	26 889.0	4 015.1	2 777.8
Peace River	18 998.1	3 532.3	2 244.5
South Saskatchewan River	17 763.7	2 816.8	1 602.0
Oldman River	16 619.6	5 106.9	2 638.9
Battle River	13 326.4	9 785.4	2 370.5
Beaver River	7 479.2	912.1	368.9
Sounding Creek	157.3	88.8	157.3
Hay River	4.8	2.5	0.5
Milk River	3.2	42.5	45.0
Non-specific basin	18 306.6	9 651.3	21 894.9
<b>Total</b>	<b>414 717.9</b>	<b>89 533.6</b>	<b>58 711.7</b>

### 3.4.2 Pesticide Sales by Natural Region

Pesticide sales were also broken down by natural region to assess pesticide sales/usage in relation to the natural regions in Alberta, which represent areas of comparable soils, climate and vegetation. This information is of interest in relation to cropping practices that are often comparable within these regions.

Pesticide sales were concentrated in three natural regions in Alberta (Table 12) (Boreal, Grassland and Parkland). The largest amount of pesticide sold, at over 34% of provincial sales, was in the Central Parkland sub-region. The Dry Mixedgrass sub-region was next at 17.7 %, followed by the Dry Mixedwood sub-region at 14%, and the Mixedgrass sub-region at 12.9%. Overall, the bulk of sales within the province were situated in the Grassland and Parkland natural regions.

Mapping of the sales by natural region was also conducted, with Figure 5 displaying the geographical locations of the natural regions and sub-regions.



**Table 12. Total Pesticide Sales by Natural Region**

<b>Natural Region</b>	<b>Sub Region</b>	<b>2013 kg ai</b>	<b>2013%</b>	<b>2008 kg ai</b>	<b>2003 kg ai</b>
<b>Alberta (non-specific region)</b>		<b>477 866.7</b>	<b>3.1</b>	<b>217 799.0</b>	<b>213 905.0</b>
Boreal	Central Mixedwood	44 419.6	0.3	21 549.7	31 486.3
	Dry Mixedwood	2 127 838.3	14.0	1 664 332.9	1 126 572.7
	Lower Boreal Highlands	3.6	0.0	2.4	0.5
	Northern Mixedwood	0.5	0.0	0	0
<b>Boreal Total</b>		<b>2 172 262.0</b>	<b>14.3</b>	<b>1 685 885.0</b>	<b>1 158 059.5</b>
Foothills	Lower Foothills	6 302.8	0.0	5 652.2	10 557.4
	Upper Foothills	2.0	0.0	15.0	29.1
<b>Foothills Total</b>		<b>6 304.8</b>	<b>0.0</b>	<b>5 667.1</b>	<b>10 586.5</b>
Grassland	Dry Mixedgrass	2 697 136.7	17.7	2 284 841.7	1 831 323.8
	Foothills Fescue	1 101 800.5	7.2	1 061 066.0	711 924.8
	Mixedgrass	1 958 689.5	12.9	2 128 080.6	1 414 122.2
	Northern Fescue	766 290.7	5.0	584 808.0	328 584.0
<b>Grassland Total</b>		<b>6 523 917.4</b>	<b>42.8</b>	<b>6 058 796.4</b>	<b>4 285 954.8</b>
Parkland	Central Parkland	5 222 417.7	34.3	3 986 293.9	3 258 822.0
	Foothills Parkland	14 854.9	0.1	8 898.9	2 113.7
	Peace River Parkland	805 637.9	5.3	510 644.9	334 291.9
<b>Parkland Total</b>		<b>6 042 910.5</b>	<b>39.7</b>	<b>4 505 837.6</b>	<b>3 595 227.6</b>
<b>Rocky Mountain</b>	Montane	<b>7 810.2</b>	<b>0.1</b>	<b>2 110.7</b>	<b>754.3</b>
<b>Total</b>		<b>15 231 071.5</b>	<b>100.0</b>	<b>12 476 095.8</b>	<b>9 264 487.7</b>

### 3.4.2 Total Pesticide Sales by Land Use Framework Region

The Government of Alberta initiated a new program in 2006 to develop a provincial land use planning blueprint to better manage public and private lands and natural resources to achieve Alberta's long term goals (Land Use Secretariat 2008). The Land Use Framework is intended to balance economic, social and environmental interests competing to utilize the same land base. The provincial framework is broken down into seven regional planning areas, which are aligned by river basins at a broad scale, and by municipal boundaries at the fine scale.

Because the Land Use Framework (LUF) boundaries roughly align with river basins, there is some alignment in Table 13 with Table 10 (agricultural sales by basin) and Table 11 (domestic sales by basin). However, the northern basins (Peace and Athabasca) are broken into two LUF regions (Upper and Lower), while the Bow, Oldman and South Saskatchewan basins are combined into one LUF region (South Saskatchewan). The Battle River is incorporated into the North Saskatchewan region, while the Beaver River is encompassed into the Lower Athabasca region (Figure 6).

The consolidation of three river basins into the South Saskatchewan region results in this region having the largest volume of sales, at over 34% of the provincial total, followed closely by the North Saskatchewan region at slightly over 30%. The bisection of the two largest river basins in Alberta (Athabasca and Peace) into Upper and Lower regions limits the relative sales for these four regional planning areas.

**Table 13. Total Pesticide Sales by Land Use Framework Region**

<b>Land Use Framework Region</b>	<b>2013 kg ai</b>	<b>%</b>	<b>2008 kg ai</b>	<b>%</b>
Alberta	477 866.7	3.1	217 799.0	1.8
Lower Athabasca	88 468.9	0.6	70 997.7	0.6
Upper Athabasca	600 898.7	3.9	434 667.3	3.5
Lower Peace	487 720.6	3.2	355 240.3	2.9
Upper Peace	1 336 283.4	8.8	1 049 653.6	8.4
North Saskatchewan	4 659 034.4	30.6	3 139 318.3	25.2
Red Deer	2 381 723.6	15.6	2 136 500.6	17.1
South Saskatchewan	5 199 075.2	34.1	5 071 919.0	40.6
<b>Total</b>	<b>15 231 071.5</b>	<b>100</b>	<b>12 476 095.8</b>	<b>100</b>

### 3.4.3 Pesticide Sales by Municipality

#### *Agricultural Pesticide Sales*

Agricultural pesticide sales were broken out by rural municipality to provide a detailed geo-administrative overview of sales, using Alberta rural municipal boundaries. The largest volume of sales (agricultural products excluding adjuvants) occurred in the counties of Vermilion River, Cypress, Forty Mile, Lethbridge and Flagstaff (>500,000 kg ai). Municipalities with greater than 300 000 kg ai of sales were the Counties of Vulcan, Wheatland, Camrose, Taber, Kneehill, Special Area 3, Spirit River and Rocky View. These are large municipalities with large proportion of total crop area in Alberta (AARD 2014). Data on primary crops grown in 2011 in the five municipalities with the highest agricultural sales was derived from the 2011 Census of Agriculture (AARD 2014)(Table 14). Acreages for major crop groups varied among municipality, however cereals (primarily wheat) dominated in each municipality at 45% or greater. Oilseeds (primarily canola) did not have relatively high acreage in comparison to wheat except in Flagstaff County, where it made up one third of cropped and summerfallow acreage. Potatoes and sugar beets accounted for most of the Other Field Crops grown in Lethbridge, while field peas and dry beans were extensively grown in the other municipalities. Hay and Forage acreage was largest in Cypress and Vermilion River Counties. Statistics Canada included data on

chemfallow acreage in 2011, so this data was included in the summary table, as chemfallow represents a significant usage of herbicide products.

The range of crop types in various municipalities influences the type of pesticides used, as well as the use intensity (rate and frequency of application). In 2008, high use intensities were observed for Taber and Lethbridge, which have large potato and sugar beet acreage. Potatoes and sugar beets use very different products than cereals and oilseeds, and pesticide use is often more intensive on these types of crops for disease suppression, weed control and insect control. However, Cypress County, with the highest use intensity reported in 2013 reported very small acreages of potatoes and sugar beets. It would appear that the use of cropping acreage and regional pesticide sales is influenced by large centres (i.e., Medicine Hat, Lethbridge) within the municipalities that serve as regional supply centres

**Table 14. Breakdown for Selected Municipalities of 2011 Crop (ha), Agricultural Pesticide Sales (2013 kg ai >500 000 kg), and Use Intensity (kg ai/ha)**

<b>Crop Group</b>	<b>Alberta</b>	<b>Vermilion</b>	<b>Cypress</b>	<b>Forty Mile</b>	<b>Lethbridge</b>	<b>Flagstaff</b>
<b>Cereals (ha)</b>	4 534 666	134 782	93 314	177 260	112 624	149 223
<b>Mixed Grains ha)</b>	137 139	4 967	4 511	1 189	1 870	2 592
<b>Oilseeds (Canola, flax, soy - ha)</b>	2 486 868	97 640	23 716	38 649	43 101	88 342
<b>Other Field crops (ha)</b>	494 142	8 620	15 019	50 757	15 460	10 110
<b>Vegetables (ha)</b>	8 674	6	0	1	596	1
<b>Hay &amp; Forage (ha)</b>	2 112 272	46 549	47 475	15 524	33 815	18 371
<b>Summer fallow (chem.-fallow) (ha)</b>	390 561	5 269	24 802	53 015	7 378	2 585
<b>Total Crop &amp; Chemfallow (ha)</b>	10 164 322	297 834	208 839	336 394	214 844	271 225
<b>Agric Sales (excl Adj) (kg ai)</b>	13 525 692	735 063	716 766	638 103	631 521	596 414
<b>Use Intensity (kg/ha)</b>	1.33	2.47	3.43	1.90	2.94	2.20

*Total Pesticide Sales*

Total sales (all sectors and all products) for all of the municipalities in Alberta are summarized in Table 15. Sales by municipality data are biased slightly by the location and distribution of vendors. Some municipalities have extensive agricultural operations with a limited number of outlets, while other municipalities serve as regional supply outlets, and their sales may be slightly

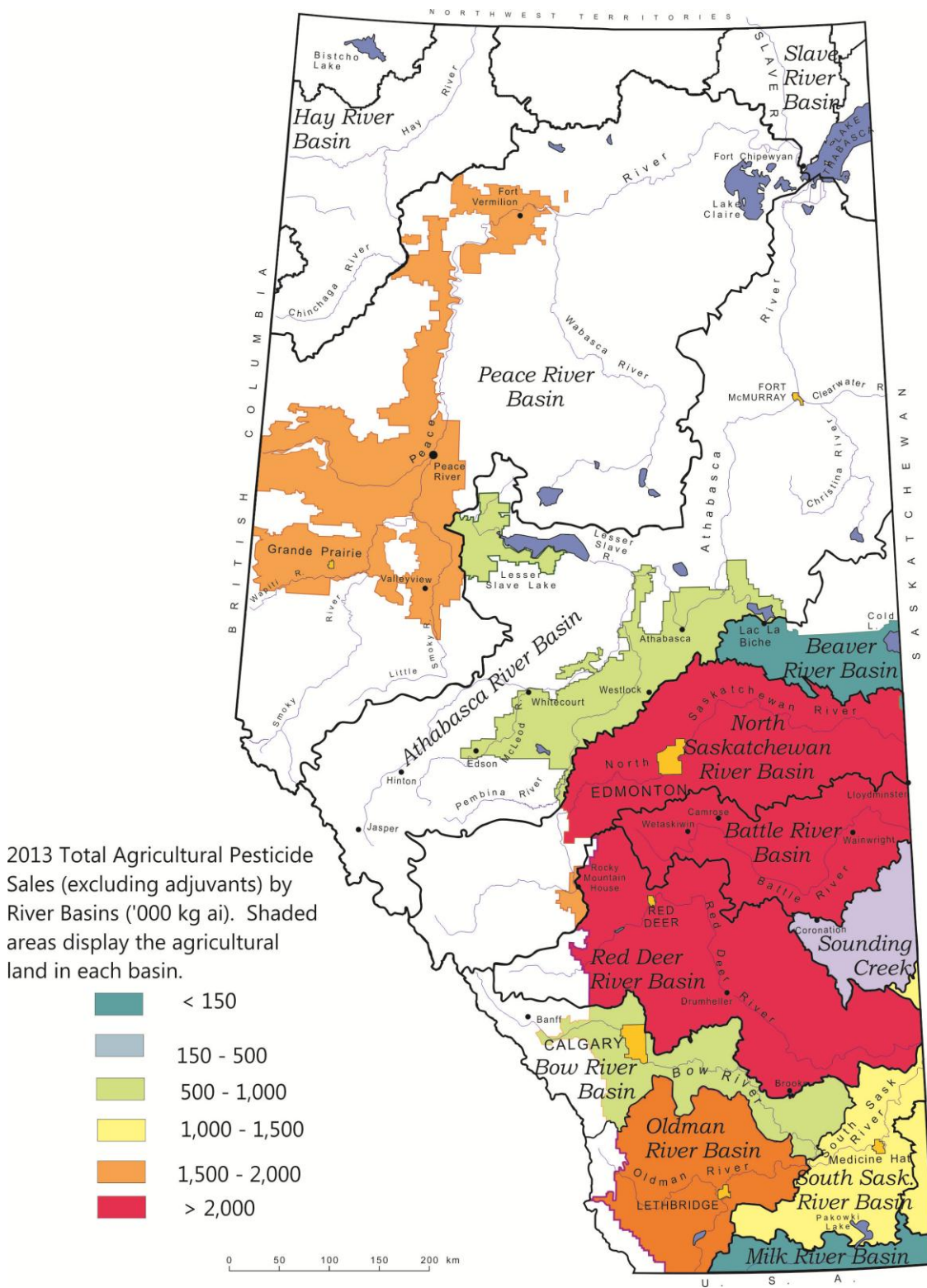
over represented in the breakdown (e.g., Lethbridge). Sales data not allocated to a specific municipality was included in the “Alberta” total.

As in previous years, the large and predominantly agricultural municipalities had the highest sales, with Vermilion River, Cypress, Forty Mile, Lethbridge and Flagstaff having the highest sales.

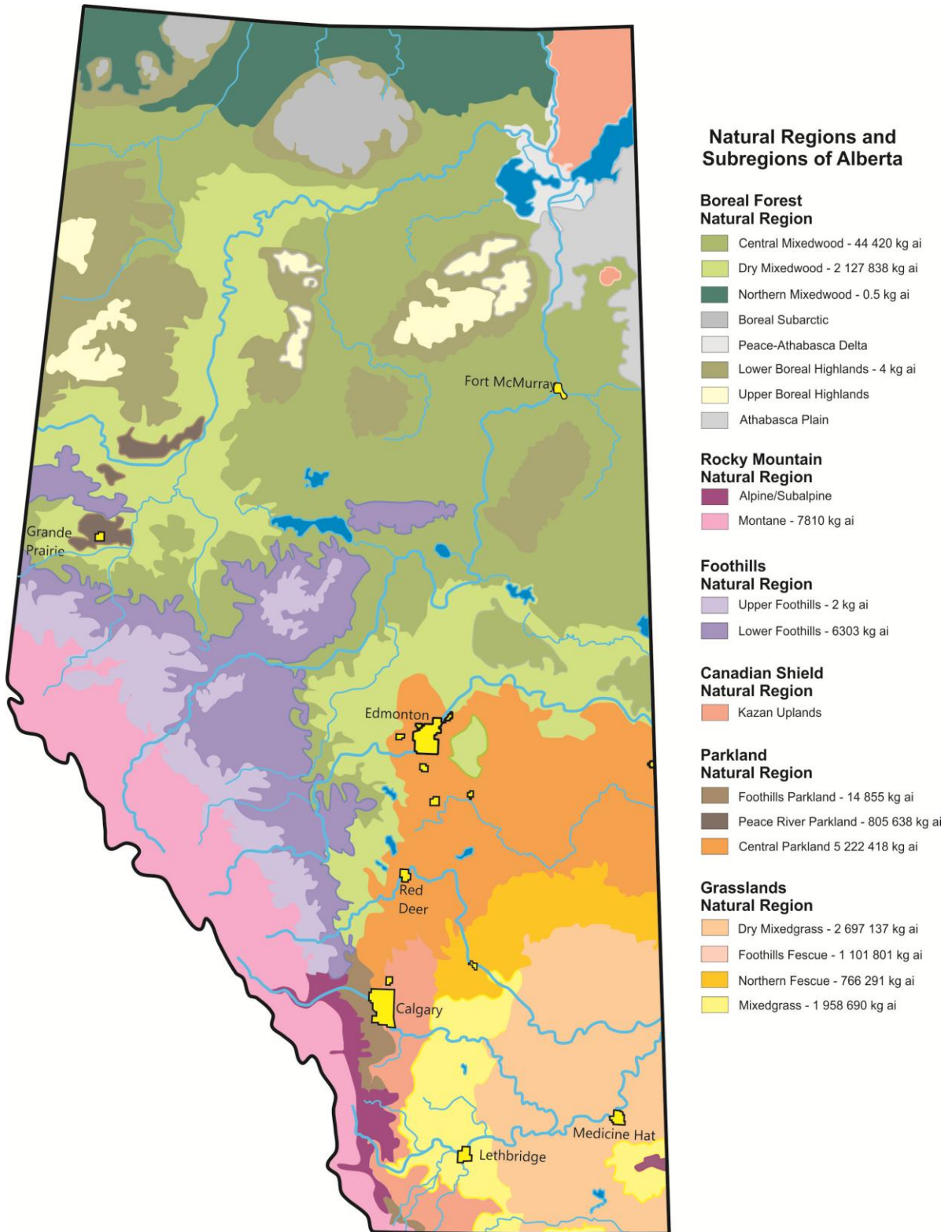
At the other end of the spectrum, pesticides sold in the National Parks were primarily domestic lawn and garden products. A graphical depiction of pesticide sales by municipality is given in Figure 7.

**Table 15. Total Pesticide Sales by Municipality (2013)**

<b>Municipality</b>	<b>kg ai</b>	<b>Municipality</b>	<b>kg ai</b>	<b>Municipality</b>	<b>kg ai</b>
Vermilion River	808 831.8	Newell	221 644.6	Bonnyville	73 970.6
Cypress	791 224.6	Lamont	215 014.8	Lacombe	65 941.5
Forty Mile	710 090.5	Drumheller	209 349.8	Athabasca	64 582.4
Lethbridge	696 188.8	Wainwright	195 562.1	Stettler	61 549.4
Flagstaff	640 118.6	Northern Sunrise	190 500.6	Peace	58 885.4
Vulcan	523 292.7	Ponoka	189 640.5	Big Lakes	51 941.0
Wheatland	500 929.3	Fairview	188 362.2	Yellowhead	41 242.6
Camrose	497 449.0	Strathcona	177 994.8	Clear Hills	40 612.2
Taber	493 289.6	St. Paul	172 194.4	Thorhild	38 351.6
Alberta	477 866.7	Cardston	166 498.9	Lac Ste. Anne	34 573.1
Grande Prairie	349 495.2	Barrhead	164 948.4	Clearwater	21 824.9
Kneehill	349 211.3	Willow Creek	163 576.0	Wood Buffalo	13 131.3
Spirit River	340 380.6	Special Area 2	154 811.2	Brazeau	12 980.3
Rocky View	339 465.8	Mackenzie	152 092.4	Greenview	9 284.1
Special Area 3	338 455.2	Starland	145 409.0	Woodlands	5 964.6
Minburn	302 310.6	Northern Lights	144 487.2	Lesser Slave River	3 688.2
Provost	277 920.6	Foothills	140 751.7	Bighorn	2 561.6
Beaver	277 038.2	Smoky Lake	139 312.7	Saddle Hills	2 230.5
Smoky River	260 105.6	Special Area 4	135 711.0	Ranchland	1 984.4
Paintearth	248 066.6	City of Calgary	131 392.7	Lac La Biche	1 367.0
Mountain View	243 372.0	Two Hills	125 186.7	Acadia	803.0
Warner	241 788.1	City of Edmonton	106 912.8	Opportunity	640.5
Red Deer	239 403.3	Parkland	94 581.5	Jasper Nat. Park	165.8
Sturgeon	238 573.3	Birch Hills	86 927.8	Elk Island Nat. Park	32.0
Westlock	233 792.6	Wetaskiwin	83 723.0	Banff Nat. Park	9.6
Leduc	233 120.8	Pincher Creek	74 386.4		
				<b>Total</b>	<b>15 231 071.5</b>



**Figure 4. Total Agricultural Pesticide Sales (excluding adjuvants) By River Basin ('000 kg ai) - 2013**



**Figure 5. Total Pesticide Sales by Natural Regions and Subregions (kg ai) - 2013**

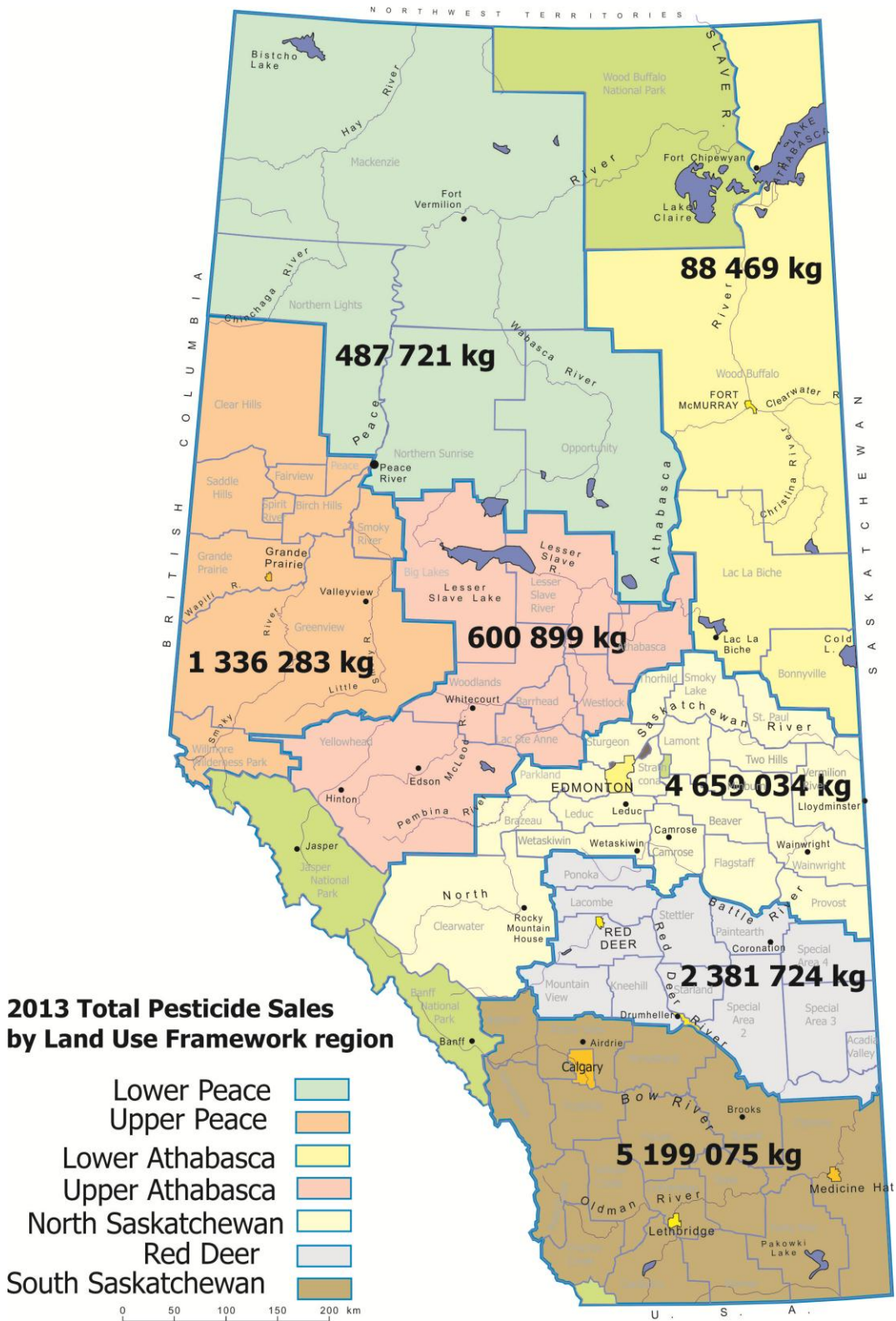
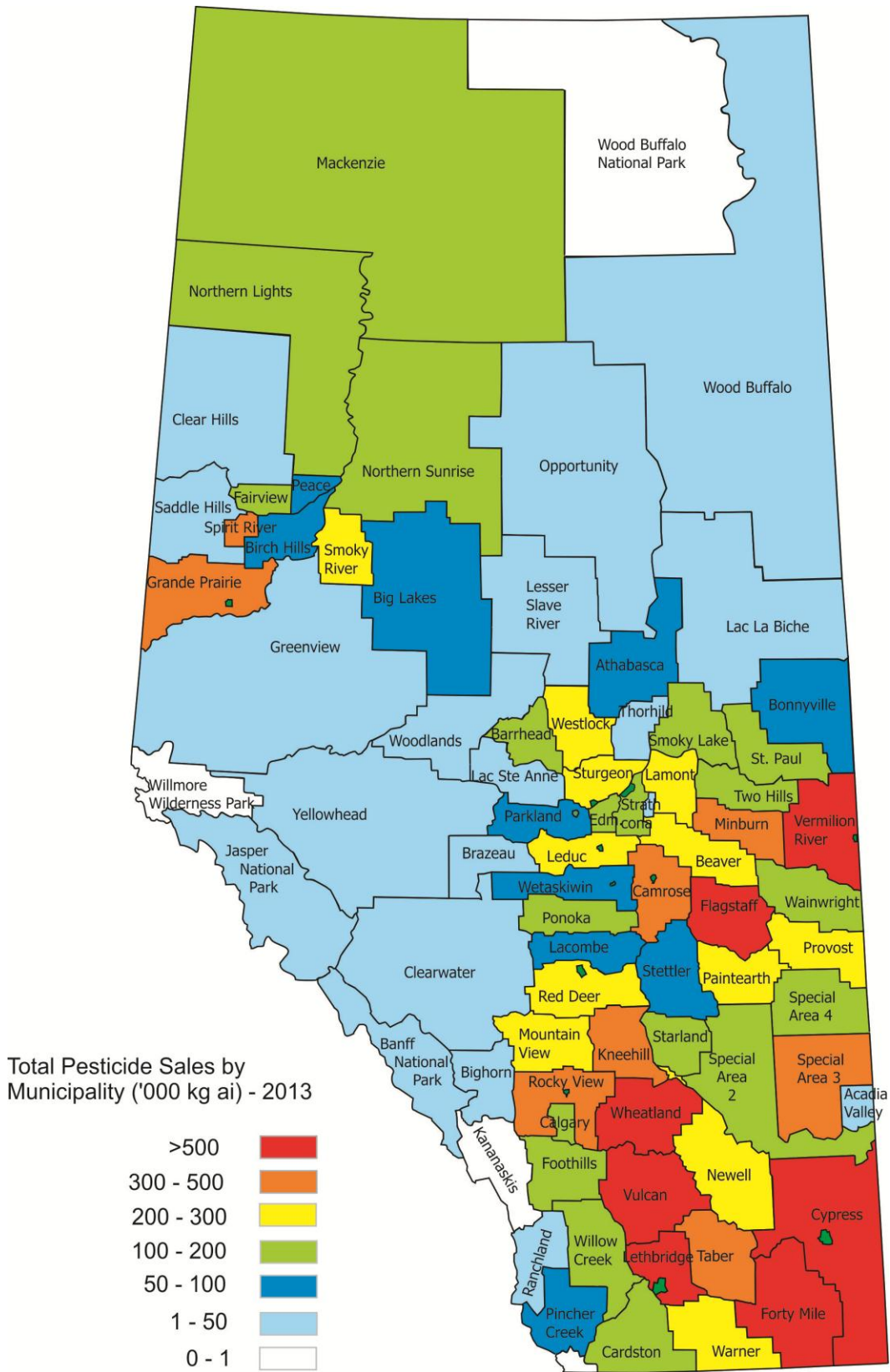


Figure 6. Total Pesticide Sales by Land Use Framework Region (kg ai) – 2013



**Figure 7. Total Pesticide Sales by Municipality ('000 kg ai) - 2013**



## 4.0 DISCUSSION

### 4.1 Use Intensity-Alberta

The first pesticide sales survey was conducted in Alberta for the 1988 to 1993 period for agricultural products only. It was followed by a comprehensive multi-sector survey in 1998, 2003, and 2008. The 1988 to 1993 sales data were based upon data obtained from the major line companies operating in Alberta at the time (e.g., grain handling companies). It did not include the sales data from independent dealers, which was estimated to make up approximately half of the market at the time. In order to make the 1988 and 1993 data consistent with more recent reporting, the sales totals obtained for those two years were doubled. The 1998, 2003, 2008 and 2013 surveys include data from the line companies and independent dealers, and are more comprehensive.

Total agricultural sales for those years were determined, and correlated to cropland information obtained from the Census of Agriculture, also carried out every 5 years (Pekalski 1995, AAFRD 2002; AARD 2009, AARD 2014) (Table 16). The timing of the Census of Agriculture (years ending in 1 and 6) and the pesticide sales survey (years ending in 3 and 8) do not match, but the closest time periods are used for comparing and calculating overall agricultural pesticide use intensity for Alberta.

**Table 16. Agricultural Pesticide use comparisons 1988-2013 (excluding adjuvants)**

	1988	1993	1998	2003	2008	2013
<b>Ag Pesticide Sales (kg ai)</b>	6 956 950*	7 491 440*	7 588 662	7 561 854	10 409 646.5	13 525 691.8
<b>Cropland area (ha)(census survey year in brackets)</b>	9 162 850 (1986)	9 292 374 (1991)	9,546,886 (1996)	9 728 527 (2001)	10 222 234 (2006)	10 164 322 (2011)
<b>Pesticide use intensity (kg/ha)</b>	0.76	0.81	0.79	0.78	1.02	1.33

\*Reported sales in 1988 and 1993 were adjusted to provide an estimated total that could be compared to other years.

Overall agricultural pesticide use intensity was relatively consistent in Alberta between 1988 and 2003, fluctuating around 0.8 kg/ha. By 2008 however, overall pesticide use intensity increased to over 1 kg/ha, an increase of over 28% from 2003, mainly a result of increased sales of glyphosate products (Table 4). Between 2008 and 2013, use intensity increased over 30% to 1.33 kg/ha, again as a result of increased glyphosate sales, and to a lesser extent, glufosinate sales.

The Statistics Canada agricultural census was changed between 2001 and 2006 to distinguish summerfallow practices between tillage and chemfallow, or a combination of both. The chemfallow and combined tillage/chemfallow acreages were summed to arrive at the additional acreage used in 2008 and 2013. This acreage was included to reflect the increased use of glyphosate as a tool for controlling weeds on fallow land. Cropland acreage used for the use intensity calculation also increased in 2008, mainly as result of including 660,000 ha of chemfallow in the total. This trend was carried into 2013.

More detailed breakdown of pesticide sales by municipality (Figure 7) and calculated use intensity (Table 14) shows that high sales areas correspond to high use areas because of cropping practices in the area or proportionally large areas of productive farmland.

## **4.2 Pesticide Use – Other Regions**

### *National*

The Pest Management Regulatory Agency has undertaken national pesticide sales reporting, based on sales reported by registrants. This initiative started in 2008, after a pilot project in 2007. While more comprehensive in terms of the products included in the reporting, difficulties in determining regional distribution does not enable detailed provincial sales breakdowns. The reporting is also structured similar to Quebec's reporting, with detailed reporting only at the chemical group level, while active ingredient reporting is grouped by range of sales totals. The chemical group sales reporting is included in Appendix 2, with the comparable Alberta and Quebec sales. Sales reports for the national sales and Quebec sales were only available for 2011 at the time of preparation of the Alberta sales report.

What the national sales figures showed was that the highest proportion of pesticides sold nationally was the Phosphonic and Phosphinic Acids (primarily glyphosate and glufosinate). Alberta's proportion of national sales was in the order of 25%, which compares to historical figures for Alberta's overall pesticide sales as a proportion of national agricultural sales. Alberta's total sales only account for about 17% of overall national sales, however large volumes of wood preservatives such as creosote, chromic acid and others that were not captured in the Alberta's sales survey affected the direct comparison.

*Quebec*

The most recent sales data from Quebec is from 2011(Gorse and Balg 2014). Quebec pesticide sales in that year amounted to 3.84 million kg of active ingredient, and the sales have been fairly consistent since reporting started in 1992 (fluctuating in the range between 3.5 and 4.1 million kg). Alberta’s total pesticide sales in 2013 was 15.2 million kg of active ingredient, approximately four times that of Quebec’s.

The distribution in type of use is markedly different between the two provinces (Table 17). Herbicide sales in Quebec made up only 62.8% of total sales, while Alberta’s herbicide sales made up over 82% of total sales. In Alberta, sales of adjuvants associated with the high proportion of herbicide sales were also proportionately high compared to Quebec. On the other hand, sales of insecticides were both proportionately and numerically higher in Quebec than Alberta, reflecting different pest pressures in that region of the country. Fungicide sales in Quebec used to be higher than in Alberta, but that has recently changed with greater fungicide usage in Alberta.

**Table 17. Total Pesticide Sales by Type of Use for Alberta and Quebec**

Type of Use	Alberta		Quebec	
	2013 kg ai	2013 (%)	2011 kg ai	2011%
Herbicides	13 195 904.6	82.2	2 418 473	62.75
Fungicides	807 882.6	3.1	554 996	14.4
Insecticides, Acaracides, Repellents	200 571.5	1.9	578 121	15
Adjuvants and Surfactants	1 010 264.9	12.7	125 260	3.25
Vertebrate Control Products and Vertebrate Repellents	11 334.1	0.1	3 854	0.1
Biocides	225.8	0	138 749	3.6
Soil Sterilants	0	0	23 125	0.6
Plant Growth Regulators	4 435.4	0.03	9 635	0.25
Other	452.6	0.01	1 927	0.05
<b>Total</b>	<b>15 231 071.5</b>	<b>100</b>	<b>3 854 140</b>	<b>100</b>

Quebec uses chemical groups to report on pesticide sales instead of individual active ingredients. Their top five groups are the Phosphonic/Phosphinic acids (39.4%), Biscarbamates (7.1%), Anilides (6.4%), Phenoxy Acids (4.9%), and Inorganics (4.1%). In Alberta, the top five chemical groups in sales are the Phosphonic/Phosphinic Acids (61.9%), Phenoxy acids (10.8%) Fatty

Acids and Surfactants (4.9%), Triazoles (2.7%), and Benzonitriles (2.5%) (Appendix 2). This comparison illustrates that the makeup of products sold in Quebec and Alberta is dominated by the Phosphonic/Phosphinic acids (primarily glyphosate). Phenoxy acids (mainly 2,4-D & MCPA) are also heavily used in both provinces. However, other than these two groups, the remaining high volume chemical groups were considerably different. Alberta's next major group is predominately adjuvants and surfactants, while Quebec's are dominated by fungicides (Biscarbamates). One change for Alberta was the increased sales of Triazoles (fungicides) which could be attributed to higher crop yields and disease pressure in 2013.

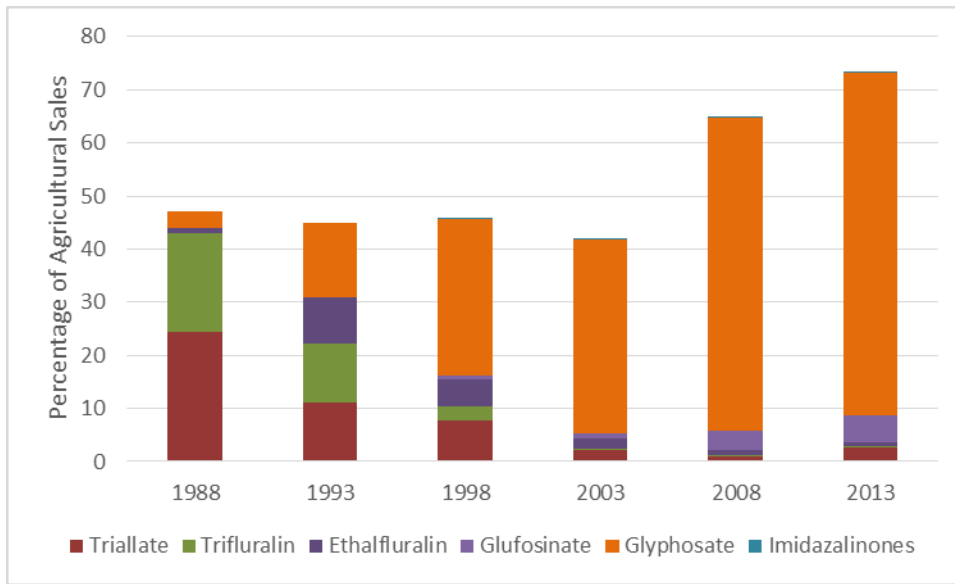
### **4.3 Selected Herbicide Sales**

Pesticide use and pesticide use changes over the past 20 years have been influenced by the development of herbicide tolerant canola, conservation tillage adoption, herbicide resistance concerns and the general evolution of products as new chemistry comes onto the market. Prior to herbicide tolerant canola coming onto the market, a wide spectrum of herbicides was required to control various broadleaf and grassy weeds in canola. Herbicide tolerant canola allowed full spectrum weed control with a single product (primarily glyphosate, although glufosinate and the imidazolinones such as imazethapyr and imazamox have found niches). Conservation tillage (or zero tillage) has also changed the spectrum of herbicides used for weed control, moving away from weed specific herbicides towards a broad spectrum product like glyphosate.

Agricultural pesticide sales data reflect the changes in products used on herbicide tolerant canola and cereals (Figure 9). Pre-emergent herbicides used primarily on conventional canola, but also on other crops (i.e., triallate, ethalfluralin and trifluralin) have dropped in sales volume over the past 20 years, related in large part to the shift in herbicide tolerant canola varieties being seeded. Triallate dropped from 693 178 kg ai in 1998 to 101 072 kg ai by 2008 as resistance issues and zero tillage increased, but recently increased to 367 417 kg ai in 2013 as triallate is now being brought back into a herbicide rotation for resistance management (Smith 2015). Ethalfluralin and trifluralin have decreased continuously over the period from 1998-2013. On the other hand, glyphosate increased significantly each reporting period, going from 2.7 million kg ai in 1998 to 8.7 million kg ai by 2013 as conservation tillage has become widespread, along with label expansions for pre crop emergence, pre-harvest and post-harvest applications (Appendix 2).

While not all of the glyphosate sales can be directly attributed to changes in canola cropping practices, the shift to glyphosate tolerant canola has had a major influence on glyphosate usage.

In addition to glyphosate tolerant canola influencing glyphosate sales, producers also adopted zero-tillage practices throughout the 1990's and 2000's, using glyphosate for pre-seeding weed control instead of tillage. Additionally, some of the increase in glyphosate use can be attributed to other changes in farming practices such as the decline in fallow tillage in favour of 'chemfallow', and the use of glyphosate for in-crop weed control prior to harvest.



**Figure 8. Selected Herbicide Sales (1988-2013)**

#### 4.4 Agricultural Insecticides

Agricultural insecticide use fluctuates considerably from year to year. Insect outbreaks characterized 1998 (Lygus bug) and 2003 (grasshopper) insecticide sales. Insect pest pressures were considerably less in 2008, and further decreased in 2013. Meers (2013) reported that extensive spraying for Bertha armyworm occurred in 2013 (40 500 ha), but other crop insect pests were low or moderate problems.

In 2013, insecticides accounted for only 1.3% of all agricultural use, and chlorpyrifos made up 24% of that volume. Although chlorpyrifos was the insecticide with the largest sales in 2013, sales dropped from 197 765 kg ai in 2003 to 82 729 kg ai in 2008 to 36 494 kg ai in 2013. Carbaryl, another insecticide with previously large agricultural sales, saw sales dropping from 104 430 kg ai in 2003 to 9 787 kg ai in 2008 to 1 667 kg ai in 2013.

Sales of the treated seed insecticides (clothianidin, thiamethoxam and imidacloprid) were reported in 2013. Treated seed sales were not collected in previous sales surveys, so there are no previous reference points. Clothianidin and thiamethoxam had similar levels of agricultural sales (28 024.6 kg and 24 992.3 kg ai respectively). Imidacloprid sales were 9 492.8 kg ai.

#### **4.5 Spatial Data**

The pesticide sales data was sorted in a number of ways to provide some spatial perspective. The spatial sorts were done by municipality, by natural region, by Land Use Framework region, and by drainage basin. The municipality level was the highest level of resolution attempted, with over 60 polygons involved. Interpreting data at this scale is problematic as vendors are not evenly distributed amongst municipalities, and some major distribution centres (e.g., Lethbridge, Medicine Hat) influence some of the spatial interpretation of the data.

At the river basin scale, there are fewer polygons involved, resulting in slightly better confidence in the spatial assessment. For water quality monitoring purposes, the breakdown of pesticide sales by river basin is a useful tool in determining monitoring priorities. A detailed breakdown on pesticide sales by active ingredient and river basin is outlined in Appendix 4

Changes in pesticide sales were consistent over most of the geographical areas between 2008 and 2013. The Land Use Framework regions are a new regional context to assess pesticide sales, and with 80% of total pesticide sales in three of the seven regions (North Saskatchewan, Red Deer, and South Saskatchewan), this reflects on the large amount of agricultural inputs used in this part of the province.

## 5.0 CONCLUSIONS

The overview of 2013 pesticide sales data provides a general background for assessing pesticide management programs and pesticide monitoring programs. Product breakdowns and regional distributions are comparable to results observed in 2008, although increasing utilization of the active ingredient glyphosate was again observed, similar to the observation made in 2003 and 2008.

Key results of the 2013 survey are:

- Total sales volume was almost **15.2** million kg of active ingredient.
- Herbicides and plant growth regulators made up **86.7%** of the total volume sold.
- Of the chemical groups, the Phosphonic/Phosphinic Acid group had the highest sales, comprising **61.9%** of total pesticide sales.
- From this chemical group, glyphosate sales accounted for **8.7** million kg ai, 57.3% of total sales, a 40% increase over 2008 and over 2.5 times the 2003 sales.
- The Agriculture sector accounted for **95.3%** of all pesticides sold in Alberta, with 87% of that being herbicides, and 5% being fungicides.
- The Commercial/Industrial sector accounted for **2.0%** of all pesticides sold in Alberta, with herbicides making up 80% and fungicides 8%.
- The Domestic sector accounted for **2.7%** of total pesticide sales, with herbicides making up 88% and insecticides 8.6% of that sector.
- Spatially, the Oldman, Red Deer, North Saskatchewan, South Saskatchewan, Battle and Peace River basins each had over **1** million kg ai of agricultural pesticide sales (excluding adjuvants).
- The South Saskatchewan River Land Use Framework region had the highest proportion of pesticide sales at over **34%**. The Lower Athabasca region had the lowest proportion of sales at **0.6%** of pesticide sales.
- The Central Parkland natural region had the largest volume of sales by natural region, at over **5.2** million kg ai.
- Average agricultural pesticide use intensity for Alberta was estimated at **1.33** kg ai/ha.

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**Appendix 1. Chemical Groups and Active Ingredients - 2013**

<b>CHEMICAL GROUP</b>	<b>ACTIVE INGREDIENT NAME</b>	<b>TYPE OF USE</b>
Acylureas	BENTAZON	Herbicide
	BROMACIL	Herbicide
	CYMOXANIL	Fungicide
	DIFLUBENZURON	Insecticide
	HEXAZINONE	Herbicide
	IPRODIONE	Fungicide
	TERBACIL	Herbicide
	ALCOHOLS, C9-11, ETHOXYLATED	Adjuvant
Alcohols	BUTOXPOLYPROPYLENE GLYCOL	Insecticide
	P-MENTHANE-3, 8-DIOL	Insecticide
	SILOXYLATED POLYETHER	Adjuvant
Aldehydes	METALDEHYDE	Insecticide
Amides	CAPSAICIN (OLEORESIN CAPSICUM)	Vertebrate
	DAMINOZIDE	Plant Growth Regulator
	MANDIPROPAMID	Fungicide
	NAPROPAMIDE	Herbicide
	PIPERINE	Vertebrate
	SAFLUFENACIL	Herbicide
Ammoniums, Quaternary	CHLORMEQUAT	Plant Growth Regulator
	DIDECYL DIMETHYL AMMONIUM CHLORIDE	Disinfectant
	DIFENZOQUAT	Herbicide
	DIQUAT	Herbicide
	N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	Disinfectant
Anilides, Anilines	PARAQUAT	Herbicide
	BOSCALID	Fungicide
	FENHEXAMID	Fungicide
	FLUMIOXAZIN	Herbicide
	FLUXAPYROXAD	Fungicide
	METALAXYL	Fungicide
	METALAXYL-M	Fungicide
	PENFLUFEN	Fungicide
	PENTHIOPYRAD	Fungicide
	SEDAXANE	Fungicide
	S-METOLACHLOR	Herbicide
Aryloxyphenoxy Acids	CLODINAFOP-PROPARGYL	Herbicide
	FENOXAPROP-P-ETHYL (ISOMER)	Herbicide
	FLUAZIFOP-P-BUTYL	Herbicide
	QUIZALOFOP P-ETHYL	Herbicide
Azoles, Oxazoles, Thiazoles	1,2-BENZISOTHIAZOLIN-3-ONE	Preservative
	ETRIDIAZOLE	Fungicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	FLUDIOXONIL	Fungicide
	PINOXADEN	Herbicide
	PYRASULFOTOLE	Herbicide
	SPIROTETRAMAT	Insecticide
	STRYCHNINE	Vertebrate
	THIABENDAZOLE	Fungicide
	TOPRAMEZONE	Herbicide
Benzamides	CHLORANTRANILIPROLE	Insecticide
	DEET	Insecticide
	FLUOPICOLIDE	Fungicide
	PROPYZAMIDE	Herbicide
	TEBUFENOZIDE	Insecticide
	ZOXAMIDE	Fungicide
Benzoic Acid & Derivatives	DICAMBA	Herbicide
	QUINCLORAC	Herbicide
Benzonitriles	BROMOXYNIL	Herbicide
	CHLOROTHALONIL	Fungicide
	DICHLORBENIL	Herbicide
Biscarbamates	DESMEDIPHAM	Herbicide
	FERBAM	Fungicide
	MANCOZEB	Fungicide
	MANEB	Fungicide
	METIRAM	Fungicide
	PHENMEDIPHAM	Herbicide
	THIOPHANATE-METHYL	Fungicide
	THIRAM	Fungicide
	ZINEB	Fungicide
Carbamates	BIFENAZATE	Insecticide
	CARBARYL	Insecticide
	EPTC	Herbicide
	FAMOXADONE	Fungicide
	METHOMYL	Insecticide
	OXADIAZON	Herbicide
	OXAMYL	Insecticide
	PROPAMOCARB HYDROCHLORIDE	Fungicide
	PROPOXUR	Insecticide
	TRIALATE	Herbicide
Chromenones	BRODIFACOU	Vertebrate
	BROMADIOLONE	Vertebrate
	DIFETHIALONE	Vertebrate
	ROTENONE	Insecticide
	WARFARIN	Vertebrate
Complex Mixture	EXTRACT OF <i>REYNOUTRIA SACHALINENSIS</i>	Fungicide
Cyclohexanedione oximes	CLETHODIM	Herbicide
	SETHOXYDIM	Herbicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	TEPRALOXYDIM	Herbicide
	TRALKOXYDIM	Herbicide
Diazines	6-BENZYLAMINOPURINE	Plant Growth Regulator
	ANCYMIDOL	Plant Growth Regulator
	MALEIC HYDRAZIDE	Plant Growth Regulator
	PYRAZON	Herbicide
	PYRIDABEN	Insecticide
	SULFAQUINOXALINE	Vertebrate
Dinitrobenzenes	BROMETHALIN	Vertebrate
	ETHALFLURALIN	Herbicide
	FLUAZINAM	Fungicide
	PENDIMETHALIN	Herbicide
	TRIFLURALIN	Herbicide
Dithiophosphates	DIMETHOATE	Insecticide
	MALATHION	Insecticide
	PHORATE	Insecticide
	PHOSALONE	Insecticide
Fatty Acids & Surfactants	AMMONIUM SOAP OF FATTY ACID	Herbicide
	METHYLATED CANOLA OIL	Adjuvant
	NONYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	OCTADEC-9-ENOIC ACID, METHYL ESTER	Adjuvant
	OCTYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	PARAFFIN BASE MINERAL OIL (ADJUVANT)	Adjuvant
	PARAFFIN BASE PETROLEUM OIL	Adjuvant
	POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adjuvant
	POTASSIUM SALTS OF FATTY ACIDS	Insecticide
	SAFER'S INSECTICIDAL SOAP	Insecticide
	SOAP (INSECTICIDAL)	Insecticide
	SURFACTANT BLEND	Adjuvant
	SURFACTANT MIXTURE	Adjuvant
	TALLOW FATTY ACID AMINE ETHOXYLATE	Adjuvant
	TRIETHANOLAMINE SALTS OF FATTY ACIDS	Insecticide
	TRIGLYCERIDE ETHOXYLATE 10 POE	Adjuvant
Guanidines	CLOTHIANIDIN	Insecticide
	CYPRODINIL	Fungicide
	HYDRAMETHYLNON	Insecticide
	IMIDACLOPRID	Insecticide
	PYRIMETHANIL	Fungicide
	STREPTOMYCIN	Fungicide
	THIAMETHOXAM	Insecticide

<b>CHEMICAL GROUP</b>	<b>ACTIVE INGREDIENT NAME</b>	<b>TYPE OF USE</b>	
Halogenated Organic Acids	AMINOPYRALID	Herbicide	
	CLOPYRALID	Herbicide	
	FLUROXYPYR	Herbicide	
	PICLORAM	Herbicide	
Hydrocarbons	ASPHALT SOLIDS	Fungicide	
	NAPHTHALENE	Insecticide	
	PETROLEUM HYDROCARBON BLEND	Adjuvant	
	POLYMERIZED BUTENES	Vertebrate	
Imidazolinones	FENAMIDONE	Fungicide	
	IMAZAMETHABENZ	Herbicide	
	IMAZAMOX	Herbicide	
	IMAZETHAPYR	Herbicide	
Indanediones	IMAZAPYR	Herbicide	
	CHLOROPHACINONE	Vertebrate	
	DIPHACINONE	Vertebrate	
Inorganic Coppers	COPPER (CUPRIC) HYDROXIDE	Fungicide	
	COPPER NAPHTHENATE	Wood	
	COPPER OXYCHLORIDE	Fungicide	
	COPPER SULPHATE	Fungicide	
	COPPER SULPHATE TRIBASIC	Fungicide	
Inorganic Zincs	ZINC NAPHTHENATE	Wood	
Inorganics, Other	ALUMINUM PHOSPHIDE	Insecticide	
	BORACIC ACID	Insecticide	
	BORAX	Insecticide	
	CALCIUM POLYSULPHIDE	Fungicide	
	FERRIC PHOSPHATE	Insecticide	
	FERROUS SULFATE	Herbicide	
	FOSETYL-AL	Fungicide	
	HYDROGEN PEROXIDE	Fungicide	
	IRON FeHEDTA	Herbicide	
	MONO- AND DIBASIC SODIUM, POTASSIUM, AND AMMONIUM PHOSPHITES	Fungicide	
	POTASSIUM BICARBONATE	Fungicide	
	POTASSIUM MONOPERSULPHATE	Disinfectant	
	SILICA AEROGEL	Insecticide	
	SILICON DIOXIDE FRESH WATER FOSSILS	Insecticide	
	SILICON DIOXIDE SALT WATER FOSSILS	Insecticide	
	SULPHUR (FUNGICIDE)	Fungicide	
	SULPHUR (INSECTICIDE)	Insecticide	
	SULPHUR (VERTEBRATE CONTROL)	Vertebrate	
	Methoxyacrylates	AZOXYSTROBIN	Fungicide
		PICOXSTROBIN	Fungicide
PYRACLOSTROBIN		Fungicide	
TRIFLOXYSTROBIN		Fungicide	
Microbials	<i>BACILLUS FIRMUS</i> I-1582	Insecticide	
	<i>BACILLUS SUBTILIS</i> (MB1600)	Insecticide	

<b>CHEMICAL GROUP</b>	<b>ACTIVE INGREDIENT NAME</b>	<b>TYPE OF USE</b>
	<i>BACILLUS SUBTILIS</i> (QT713)	Insecticide
	<i>BACILLUS THURINGIENSIS</i> <i>SSP KURSTAKI</i>	Insecticide
	<i>BACILLUS THURINGIENSIS</i> , SEROTYPE H-14	Insecticide
	<i>BEAUVERIA BASSIANA</i> STRAIN GHA	Insecticide
	<i>CONIOTHYRIUM MINITANS</i> STRAIN CON/M/91-08	Fungicide
	<i>GLIOCLADIUM CATENULATUM</i>	Fungicide
	<i>METARHIZIUM ANISOPLIAE</i> (STRAIN F52)	Insecticide
	<i>PAECILOMYCES FUMOSOROSEUS</i> STRAIN FE 9901	Insecticide
	<i>SCLEROTINIA MINOR</i> IMI 3144141	Herbicide
	<i>STREPTOMYCES GRISEOVIRIDIS</i>	Fungicide
	<i>STREPTOMYCES LYDICUS</i>	Fungicide
	<i>TRICHODERMA HARZIANUM</i> RIFAI STRAIN KRL-AG2	Fungicide
Miscellaneous (Non-Classified)	1-OCTEN-3-OL	Insecticide
	ACROLEIN	Herbicide
	BISPYRIBAC	Herbicide
	BRONOPOL	Preservative
	CELLULOSE (FROM POWDERED CORN COBS)	Vertebrate
	COAL TAR OILS	Disinfectant
	CORN GLUTEN MEAL	Herbicide
	DRIED BLOOD	Vertebrate
	DRIED WHOLE EGGS	Vertebrate
	ETHOFUMESATE	Herbicide
	FISH MEAL MIXTURE	Vertebrate
	FISH OIL MIXTURE	Vertebrate
	LIQUID CORN GLUTEN	Herbicide
	MEAT MEAL MIXTURE	Vertebrate
	METHYL NONYL KETONE	Vertebrate
	NATURAL GUM RESINS	Insecticide
	PIPERONYL BUTOXIDE	Insecticide
	PUTRESCENT WHOLE EGG SOLIDS	Vertebrate
Morpholines & Oxathiines	CARBATHIIN	Fungicide
	DIMETHOMORPH	Fungicide
	DODEMORPH-ACETATE	Fungicide
Nitrobenzenes	FOMESAFEN	Herbicide
	OXYFLUORFEN	Herbicide
Oils, Mineral and Vegetable	CASTOR OIL	Vertebrate
	GARLIC OIL	Insecticide
	MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insecticide
	OIL OF BLACK PEPPER	Vertebrate

<b>CHEMICAL GROUP</b>	<b>ACTIVE INGREDIENT NAME</b>	<b>TYPE OF USE</b>
	WINTERGREEN OIL	Vertebrate
Organic Acids	ABAMECTIN	Insecticide
	ACEQUINOCYL	Insecticide
	ACETIC ACID	Herbicide
	CITRIC ACID	Disinfectant
	FERRIC SODIUM EDTA	Insecticide
	GIBBERELIC ACID	Plant Growth Regulator
	LACTIC ACID	Fungicide
	SPINOSAD FACTOR A PLUS	Insecticide
	SPIROMESIFEN	Insecticide
	TRINEXAPAC-ETHYL	Plant Growth Regulator
Organochlorines	ENDOSULFAN	Insecticide
	PARADICHLOROBENZENE	Insecticide
Organometallics	FENBUTATIN OXIDE	Insecticide
Others	GARLIC POWDER	Fungicide
Phenoxy Acids	2,4-D	Herbicide
	2,4-DB	Herbicide
	4-CPA	Plant Growth Regulator
	DICHLORPROP (2,4-DP)	Herbicide
	MCPA	Herbicide
	MCPB	Herbicide
	MECOPROP (D-ISOMER)	Herbicide
	MECOPROP-P	Herbicide
	TRICLOPYR	Herbicide
Pheromones	KINOPRENE	Insecticide
	METHOPRENE	Insecticide
	Z-9-TRICOSENE	Insecticide
Phosphates	DICHLORVOS	Insecticide
	NALED	Insecticide
Phosphonic Acids, Phosphinic Acids	ETHEPHON	Plant Growth Regulator
	GLUFOSINATE AMMONIUM	Herbicide
	GLYPHOSATE	Herbicide
Phosphoramidothioates	ACEPHATE	Insecticide
	PROPETAMPHOS	Insecticide
Phthalic Acids	CAPTAN	Fungicide
	FOLPET	Fungicide
	N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insecticide
Pyrethroids, Pyrethrins	CYFLUTHRIN	Insecticide
	CYHALOTHRIN-LAMBDA	Insecticide
	CYPERMETHRIN	Insecticide
	D-CIS, TRANS ALLETHRIN	Insecticide
	DELTAMETHRIN	Insecticide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	D-PHENOTHRIN	Insecticide
	D-TRANS ALLETHRIN	Insecticide
	MEFLUTHRIN	Insecticide
	PERMETHRIN	Insecticide
	PYRETHRINS	Insecticide
	RESMETHRIN	Insecticide
	TEFLUTHRIN	Insecticide
	TETRAMETHRIN	Insecticide
Pyridines	4-AMINOPYRIDINE	Vertebrate
	ACETAMIPRID	Insecticide
	DI-N-PROPYL ISOCINCHOMERONATE	Insecticide
	FLONICAMID	Insecticide
	FLUOPYRAM	Fungicide
	PYRIPROXYFEN	Insecticide
Sulfonylureas	CHLORSULFURON	Herbicide
	ETHAMETSULFURON-METHYL	Herbicide
	FLUCARBAZONE SODIUM	Herbicide
	METSULFURON-METHYL	Herbicide
	NICOSULFURON	Herbicide
	RIMSULFURON	Herbicide
	THIFENSULFURON METHYL	Herbicide
	TRIASULFURON	Herbicide
	TRIBENURON METHYL	Herbicide
	TRIFLUSULFURON METHYL	Herbicide
Thiophosphates	CHLORPYRIFOS	Insecticide
	DIAZINON	Insecticide
Triazines, Tetrazines	ATRAZINE	Herbicide
	CLOFENTEZINE	Insecticide
	CYROMAZINE	Insecticide
	METRIBUZIN	Herbicide
	PROMETRYNE	Herbicide
	PYMETROZINE	Insecticide
	SIMAZINE	Herbicide
	THIENCARBAZONE METHYL	Herbicide
Triazoles	AMITROLE	Herbicide
	CARFENTRAZONE-ETHYL	Herbicide
	DIFENOCONAZOLE	Fungicide
	FLORASULAM	Herbicide
	IPCONAZOLE	Herbicide
	METCONAZOLE	Fungicide
	MYCLOBUTANIL	Fungicide
	PACLOBUTRAZOL	Plant Growth Regulator
	PROPICONAZOLE	Fungicide
	PROTHIOCONAZOLE	Fungicide
	PYROXSULAM	Herbicide



<b>CHEMICAL GROUP</b>	<b>ACTIVE INGREDIENT NAME</b>	<b>TYPE OF USE</b>
	SULFENTRAZONE	Herbicide
	TEBUCONAZOLE	Fungicide
	TRITICONAZOLE	Fungicide
	UNICONAZOLE-P	Plant Growth Regulator
Urea Derivatives	CYAZOFAMID	Herbicide
	DIFLUFENZOPYR	Herbicide
	DIFLUFENZOPYR-SODIUM	Herbicide
	DIURON	Herbicide
	LINURON	Herbicide

**Appendix 2. Alberta (2013), Quebec (2011) and Canada (2011) Pesticide Sales by Chemical Group**

Active Ingredient	2013 Alberta kg ai	%	2011 Quebec kg ai	%	2011 Canada kg ai	%
Phosphonic Acids, Phosphinic Acids	9 424 536.7	61.9	1 519 621	39.4	37 284 336	41.3
Phenoxy Acids	1 639 505.7	10.8	189 924	4.9	5 848 187	6.5
Fatty Acids & Surfactants	741 830.4	4.9	133 816	3.5	2 588 942	2.9
Triazoles	414 769.8	2.7	11 710	0.3	900 256	1.0
Benzonitriles	381 607.4	2.5	154 332	4.0	2 107 250	2.3
Carbamates	379 681.2	2.5	14 023	0.4	446 176	0.5
Miscellaneous (Non-Classified)	356 703.6	2.3	34 574	0.9	NR	
Halogenated Organic Acids	256 044.6	1.7	1 609	0.0	454 371	0.5
Hydrocarbons	218 049.6	1.4	138 305	3.6	8 663 657	9.6
Acyureas	189 398.9	1.2	53 429	1.4	329 087	0.4
Azoles, Oxazoles, Thiazoles	122 374.8	0.8	15 789	0.4	264 351	0.3
Dinitrobenzenes	113 793.5	0.7	36 561	0.9	881 823	1.0
Methoxyacrylates	100 570.3	0.7	6 087	0.2	XXX	
Guanidines	99 906.6	0.7	11 084	0.3	273 902	0.3
Cyclohexanedione oximes	95 701.1	0.6	2 557	0.1	193 905	0.2
Aryloxyphenoxy Acids	95 469.8	0.6	8 471	0.2	279 751	0.3
Anilides, Anilines	80 816.9	0.5	245 674	6.4	822 014	0.9
Ammoniums, Quaternary	68 066.1	0.4	28 920	0.8	1 068 053	1.2
Alcohols	56 198.2	0.4	7 543	0.2	715 133	0.8
Benzoic Acid & Derivatives	55 629.0	0.4	43 820	1.1	297 040	0.3
Imidazolinones	45 553.6	0.3	8 907	0.2	160 978	0.2
Inorganics, Other	40 399.3	0.3	159 094	4.1	10 507 073	11.6
Sulfonylureas	40 314.2	0.3	7 971	0.2	82 953	0.1
Thiophosphates	37 513.1	0.2	41 320	1.1	379 055	0.4
Biscarbamates	36 060.7	0.2	275 634	7.2	1 180 093	1.3
Urea Derivatives	27 134.3	0.2	33 493	0.9	1 486 467	1.6
Dithiophosphates	24 009.4	0.2	24 944	0.6	XXX	
Morpholines & Oxathiines	19 122.4	0.1	678	0.02	XXX	
Oils, Mineral and Vegetable	11 839.8	0.1	147 175	3.8	1 749 619	1.9
Triazines, Tetrazines	10 956.2	0.1	174 761	4.5	1 802 763	2.0
Pyrethroids, Pyrethrins	10 031.9	0.1	13 473	0.3	41 900	0.0
Amides	7 713.3	0.1	12 615	0.3	203 522	0.2
Benzamides	6 959.8	0.05	89 103	2.3	246 290	0.3
Inorganic Coppers	6 937.6	0.05	NR	0.0	1 413 131	1.6
Organic Acids	5 734.9	0.04	9 816	0.3	92 019	0.1
Nitrobenzenes	2 655.5	0.02	22 787	0.6	71 814	0.1
Microbials	2 488.4	0.02	22 922	0.6	0	0.0
Pyridines	2 263.1	0.01	1 399	0.04	12 011	0.0
Phosphates	787.2	0.01	4 718	0.1	XXX	
Diazines	691.0	0.005	7 229	0.2	32 143	0.0
Phthalic Acids	458.1	0.003	42 820	1.1	261 638	0.3
Organochlorines	450.3	0.003	16 619	0.4	1 303 014	1.4

Inorganic Zincs	146.1	0.001	NR	0.0	6 408	0.0
Phosphoramidothioates	83.0	0.001	3 282	0.1	XXX	
Aldehydes	48.9	0.000	6 565	0.2	831 407	0.9
Complex Mixture	24.0	0.000	NR	0.0	NR	
Chromenones	13.7	0.000	29	0.001	240	0.0
Organometallics	12.0	0.000	5	0.0	XXX	
Others	10.0	0.000	NR		2 761 044	3.1
Pheremones	2.8	0.000	18	0.0	508	0.0
Indanediones	2.1	0.000	5	0.0	XXX	
Phenols	1.3	0.000	NR	0.0	219 835	0.2
Dithiocarbamates	NR		65 140	1.7	801 535	0.9
Organohalogens	NR		3 322	0.1	21 561	0.0
Anilines	NR		448	0.01	NR	
<b>Grand Total</b>	<b>15 231 071.5</b>	<b>100.0</b>	<b>3 854 140</b>	<b>100.0</b>	<b>90 324 969</b>	<b>100.0</b>

XXX – indicates confidential business information. The chemical group did not contain a minimum of four registrants in the calculation of the total.

NR – no sales reported

**Appendix 3. Alberta 1998, 2003, 2008 and 2013 Pesticide Sales by Active Ingredient**

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
GLYPHOSATE	Herbicide	8 726 904.1	57.3	6 235 498.5	50	3 419 822.1	36.9	2 682 748.9	28.9
MCPA	Herbicide	920 433.3	6.0	1 028 995.8	8.2	1 097 359.0	11.8	885 239.1	9.5
GLUFOSINATE AMMONIUM	Herbicide	694 496.1	4.6	395 681.1	3.2	107 255.5	1.2	63 863.8	0.7
2,4-D	Herbicide	641 171.0	4.2	973 082.3	7.8	763 357.7	8.2	777 764.0	8.4
TRIALATE	Herbicide	367 416.9	2.4	101 072.2	0.8	197 221.4	2.1	692 497.5	7.5
CORN GLUTEN MEAL	Herbicide	330 967.4	2.2	705.6	0.006				
BROMOXYNIL	Herbicide	315 622.8	2.1	330 177.1	2.6	354 906.6	3.8	268 105.3	2.9
SURFACTANT BLEND	Adjuvant	300 914.3	2.0	403 438.3	3.2	438 235.7	4.7	496 561.7	5.4
PETROLEUM HYDROCARBON BLEND	Adjuvant	215 138.9	1.4	656 588.2	5.3	559 728.7	6	368 704.3	4
FLUROXYPYR	Herbicide	158 114.3	1.0	71 814.1	0.6	43 166.7	0.47	23 700.8	0.3
METHYLATED CANOLA OIL	Adjuvant	134 649.3	0.9	187 385.6	1.5				
TEBUCONAZOLE	Fungicide	121 566.7	0.8	15 549.0	0.1	5 922.4	0.06		
PROPICONAZOLE	Fungicide	119 339.7	0.8	50 387.5	0.4	13 183.4	0.14	5 664.4	0.06
BENTAZON	Herbicide	117 357.2	0.8	20 481.0	0.2	21 986.9	0.24	12 066.2	0.1
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adjuvant	97 257.9	0.6	55 943.9	0.4	13 727.9	0.15	9 340.0	0.1
ETHALFLURALIN	Herbicide	87 128.4	0.6	82 873.7	0.7	168 135.0	1.8	452 294.4	4.9
PROTHIOCONAZOLE	Fungicide	81 609.0	0.5	26 517.0	0.2				
CLOPYRALID	Herbicide	69 351.3	0.5	58 339.1	0.5	56 618.0	0.61	59 019.7	0.6
PINOXADEN	Herbicide	66 942.7	0.4	32 783.2	0.3				
CHLOROTHALONIL	Fungicide	65 366.9	0.4	35 693.8	0.3	43 208.6	0.47	37 334.0	0.4
PYRACLOSTROBIN	Fungicide	63 402.0	0.4	7 650.5	0.06	1 263.6	0.01		
IPRODIONE	Fungicide	62 602.7	0.4	57 374.1	0.5	21 014.3	0.23	9 592.7	0.1
PARAFFIN BASE PETROLEUM OIL	Adjuvant	62 188.2	0.4	22 939.3	0.2	27 958.4	0.3	77 427.2	0.8
DIQUAT	Herbicide	61 204.4	0.4	34 893.9	0.3	25 524.4	0.28	21 765.0	0.2

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
TRALKOXYDIM	Herbicide	57 531.4	0.4	147 916.9	1.2	141 226.1	1.5	126 323.5	1.4
ALCOHOLS, C9-11, ETHOXYLATED	Adjuvant	55 385.8	0.4						
FENOXAPROP-P-ETHYL	Herbicide	54 295.9	0.4	58 399.7	0.5	64 212.1	0.69	59 919.0	0.6
DICAMBA	Herbicide	54 119.6	0.4	94 677.9	0.8	121 422.7	1.3	138 278.6	1.5
PARAFFIN BASE MINERAL OIL	Adjuvant	45 772.7	0.3	188 738.7	1.5	192 634.4	2.1	193 162.6	2.1
NONYLPHENOXYPOLYETHOXYETHANOL	Adjuvant	38 615.1	0.3	58 634.2	0.5	59 558.8	0.64	94 247.3	1.0
CYPRODINIL	Fungicide	37 172.2	0.2	0.9	0				
TRIGLYCERIDE ETHOXYLATE 10 POE	Adjuvant	36 637.6	0.2						
CHLORPYRIFOS	Insecticide	36 526.5	0.2	82 728.7	0.7	197 765.5	2.1	217 397.5	2.3
BOSCALID	Fungicide	36 006.9	0.2	20 519.8	0.2				
TRICLOPYR	Herbicide	33 441.5	0.2	25 678.1	0.2	33 116.2	0.36	30 311.8	0.3
MECOPROP-P	Herbicide	30 815.6	0.2	43 319.9	0.3				
CLODINAFOP-PROPARGYL	Herbicide	30 330.7	0.2	46 882.3	0.4	49 520.8	0.53	34 408.9	0.4
CLETHODIM	Herbicide	30 141.6	0.2	19 955.8	0.2	3 694.9	0.04	2 490.7	0.03
PYRASULFOTOLE	Herbicide	28 218.1	0.2	6 323.6	0.05				
CLOTHIANIDIN	Insecticide	28 024.6	0.2	686.8	0.006				
FLUDIOXONIL	Fungicide	26 640.8	0.2	1 100.6	0.009	24 377.7	0.26		
THIAMETHOXAM	Insecticide	24 992.3	0.2	5 513.7	0.04	1 176.2	0.01		
AZOXYSTROBIN	Fungicide	24 967.3	0.2	4 899.6	0.04	1 961.1	0.02		
TRIFLURALIN	Herbicide	23 772.0	0.2	34 730.5	0.3	40 654.3	0.44	230 028.2	2.5
IMAZAMETHABENZ	Herbicide	22 841.4	0.1	94 004.3	0.8	138 551.4	1.5	173 679.2	1.9
DIURON	Herbicide	21 644.1	0.1	37 674.4	0.3	31 096.3	0.34	9 919.3	0.1
METCONAZOLE	Fungicide	19 637.1	0.1						
PYROXSULAM	Herbicide	19 162.1	0.1	1 251.4	0.01				
CARBATHIIN	Fungicide	19 119.5	0.1	15 231.1	0.1	45 228.3	0.49	122 292.0	1.3
FLUCARBAZONE SODIUM	Herbicide	18 309.5	0.1	8 333.0	0.07	2 292.2	0.02		

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
OCTADEC-9-ENOIC ACID, METHYL ESTER	Adjuvant	18 145.8	0.1						
MANCOZEB	Fungicide	17 758.5	0.1	22 355.4	0.2	36 127.2	0.39	45 813.9	0.5
PICLORAM	Herbicide	17 209.9	0.1	25 377.1	0.2	17 897.0	0.19	15 109.4	0.2
SILICON DIOXIDE SALT WATER FOSSILS	Insecticide	16 305.1	0.1	15 624.1	0.1	15 588.2	0.17	47 025.2	0.5
FLORASULAM	Herbicide	15 564.3	0.1	15 760.4	0.1	6 090.5	0.07		
THIRAM	Fungicide	15 129.5	0.1	76 081.8	0.6	27 136.3	0.29	22 791.7	0.2
DIFENOCONAZOLE	Fungicide	14 944.4	0.1	13 599.3	0.1	11 067.6	0.12		
SILICA AEROGEL	Insecticide	14 177.0	0.09	25 090.8	0.2	7 785.0	0.08	11 052.5	0.1
AMITROLE	Herbicide	13 566.6	0.09	4 994.4	0.04	2 107.0	0.02	2 026.5	0.02
PENTHIOPYRAD	Fungicide	13 179.3	0.09						
TRIBENURON METHYL	Herbicide	13 178.7	0.09	9 956.1	0.08	5 404.8	0.06	6 763.6	0.07
PHORATE	Insecticide	12 642.8	0.08	40 375.5	0.3	41 417.3	0.45	19 209.0	0.2
IMAZAMOX	Herbicide	12 443.4	0.08	7 773.9	0.06	3 122.0	0.03	4 231.8	0.05
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insecticide	11 819.4	0.08	3 897.7	0.03	2 233.7	0.02	3 477.4	0.04
AMINOPYRALID	Herbicide	11 369.2	0.07	4 358.4	0.03				
METALAXYL-M	Fungicide	11 010.3	0.07	4 357.1	0.03	29 813.1	0.32		
QUIZALOFOP P-ETHYL	Herbicide	10 837.2	0.07	3 673.0	0.03	4 461.0	0.05	2 669.7	0.03
ACROLEIN	Herbicide	10 367.8	0.07	9 051.0	0.07	16 981.4	0.18	17 520.5	0.2
MALATHION	Insecticide	10 075.5	0.07	13 477.1	0.1	17 413.8	0.19	22 316.5	0.2
CELLULOSE (FROM POWDERED CORN COBS)	Rodenticide	9 596.9	0.06						
IMIDACLOPRID	Insecticide	9 595.5	0.06	647.1	0.005	978.0	0.01	9.5	0
FLUXAPYROXAD	Fungicide	9 534.0	0.06						
DICHLORPROP	Herbicide	7 848.8	0.05	52 271.6	0.4	57 450.1	0.62	40 942.4	0.4
PICOXYSTROBIN	Insecticide	7 757.3	0.05						

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
SAFLUFENACIL	Herbicide	7 098.2	0.05						
IMAZAPYR	Herbicide	7 023.7	0.05	3 828.1	0.03	1 710.0	0.02	200.6	0
THIFENSULFURON METHYL	Herbicide	6 338.3	0.04	8 344.1	0.07	8 572.3	0.09	13 697.5	0.1
CYHALOTHRIN-LAMBDA	Insecticide	6 170.5	0.04	2 947.5	0.02	5 124.4	0.06	1 097.9	0.01
COPPER (CUPRIC) HYDROXIDE	Fungicide	5 931.0	0.04	3 192.6	0.03	6 885.0	0.07	252.5	0
DEET	Insecticide	5 901.4	0.04	1 201.9	0.01	3 413.3	0.04	4 167.9	0.04
TEPRALOXYDIM	Herbicide	5 885.9	0.04	4 881.3	0.04				
EPTC	Herbicide	5 688.0	0.04	11 024.0	0.09	11 944.0	0.13	38 574.2	0.4
METALAXYL	Fungicide	5 422.2	0.04	1 164.1	0.009	302.2	0	3 796.2	0.04
2,4-DB	Herbicide	5 123.5	0.03	3 640.0	0.03	11 501.4	0.12	20 950.3	0.2
ACETIC ACID	Herbicide	5 040.7	0.03	11 915.6	0.1	1 555.5	0.02		
CARBARYL	Insecticide	4 919.1	0.03	9 787.3	0.08	104 430.6	1.1	3 142.8	0.03
DIFENZOQUAT	Herbicide	4 580.6	0.03	3 792.0	0.03	4 464.0	0.05	9 585.5	0.1
BROMACIL	Herbicide	4 485.6	0.03	2 486.9	0.02	4 770.3	0.05	3 106.9	0.03
TRIFLOXYSTROBIN	Fungicide	4 443.8	0.03	7 982.0	0.06				
SULFENTRAZONE	Herbicide	4 342.4	0.03						
MONO- AND DIBASIC SODIUM, POTASSIUM, AND AMMONIUM PHOSPHITES	Fungicide	4 030.7	0.03						
LINURON	Herbicide	3 676.3	0.02	7 317.5	0.06	8 991.4	0.1	8754	0.09
METRIBUZIN	Herbicide	3 654.8	0.02	5 061.1	0.04	6 306.3	0.07	7 601.4	0.08
SEDAXANE	Fungicide	3 395.0	0.02						
HEXAZINONE	Herbicide	3 177.0	0.02	3 540.2	0.03	940.9	0.01	2 428.1	0.03
ETHEPHON	Fungicide	3 136.6	0.02	2 388.0	0.02	115.2	0	31.2	0
ATRAZINE	Herbicide	3 048.5	0.02	6 172.7	0.05	4 654.5	0.05	5 753.8	0.06
IMAZETHAPYR	Herbicide	2 946.9	0.02	6 195.7	0.05	5 063.2	0.05	10 528.6	0.1
FOMESAFEN	Herbicide	2 586.4	0.02						

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
NAPHTHALENE	Insecticide	2 449.3	0.02	2 318.2	0.02	118.5	0	1 371.6	0.01
OCTYLPHENOXYPOLYETHOXYETHANOL	Adjuvant	2 420.4	0.02	3 920.6	0.03	5 144.7	0.06	9 219.0	0.1
TALLOW FATTY ACID AMINE ETHOXYLATE	Adjuvant	2 266.9	0.01			138.1	0	3 272.2	0.04
METSULFURON-METHYL	Herbicide	2 250.9	0.01	286.3	0.002	360.9	0	938.6	0.01
LIQUID CORN GLUTEN	Herbicide	2 246.8	0.01						
CARFENTRAZONE-ETHYL	Herbicide	2 219.4	0.01	2 694.4	0.02				
FLUOPYRAM	Fungicide	2 175.3	0.01						
SIMAZINE	Herbicide	2 154.8	0.01	4 725.1	0.04	1 160.4	0.01	3 688.1	0.04
SETHOXYDIM	Herbicide	2 142.2	0.01	19 194.1	0.2	30 993.1	0.33	58 678.5	0.6
FLUAZINAM	Fungicide	2 009.3	0.01						
THIOPHANATE-METHYL	Fungicide	1 908.8	0.01	1 024.9	0.008	454.7	0	859.4	0.01
DELTAMETHRIN	Insecticide	1 896.7	0.01	537.6	0.004	2 735.1	0.03	775.1	0.01
TRITICONAZOLE	Fungicide	1 895.7	0.01	3 145.2	0.03	2 080.4	0.02		
PIPERONYL BUTOXIDE	Insecticide	1 824.3	0.01	1 607.3	0.01	405.1	0	591.6	0.01
PARAQUAT	Herbicide	1 649.6	0.01	1 727.6	0.01	1 591.6	0.02	4 820.4	0.05
<i>BACILLUS THURINGIENSIS SSP ISRAELENسيس</i>	Insecticide	1 550.2	0.01	62.2	0	34.4	0	294.2	0
PROPAMOCARB HYDROCHLORIDE	Fungicide	1 510.2	0.01	540.1	0.004	411.9	0	1 271.3	0.01
QUINCLORAC	Herbicide	1 509.3	0.01	213.2	0.002	878.1	0.01	1 459.4	0.02
PERMETHRIN	Insecticide	1 508.9	0.01	1 402.7	0.01	315.8	0	397.2	0
PENFLUFEN	Fungicide	1 446.8	0.009						
IRON FeHEDTA	Herbicide	1 351.1	0.009						
DIMETHOATE	Insecticide	1 290.3	0.008	1 456.5	0.01	1 691.1	0.02	4 883.4	0.05
PROMETRYNE	Herbicide	1 278.4	0.008	855.5	0.007	586.3	0.01		
METIRAM	Fungicide	1 188.0	0.008	619.2	0.005	2 068.8	0.02	14 862.4	0.2
DIFLUFENZOPYR	Herbicide	1 178.7	0.008						



ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
SULPHUR (FUNGICIDE)	Fungicide	1 122.4	0.007	1 523.2	0.01	2 968.1	0.03	7 315.4	0.08
CYMOXANIL	Fungicide	1 041.6	0.007			65.9	0		
DIAZINON	Insecticide	986.6	0.006	2 541.5	0.02	5 149.9	0.06	4 087.3	0.04
IPCONAZOLE	Fungicide	890.2	0.006						
PENDIMETHALIN	Herbicide	883.8	0.006	1 003.2	0.008	782.8	0.01	1 061.1	0.01
ETHOFUMESATE	Herbicide	864.0	0.006	6 518.4	0.05	7 742.4	0.08	12 559.4	0.1
AMMONIUM SOAP OF FATTY ACID	Herbicide	783.0	0.005						
THIENCARBAZONE METHYL	Herbicide	765.0	0.005						
POTASSIUM SALTS OF FATTY ACIDS	Insecticide	759.0	0.005	687.3	0.006				
DRIED BLOOD	Vertebrate	759.0	0.005	327.0	0.003				
TERBACIL	Herbicide	734.4	0.005	1 728.0	0.01	332.8	0	891.2	0.01
SULPHUR (VERTEBRATE CONTROL)	Rodenticide	726.4	0.005	11 404.8	0.09	185.4	0	1 045.3	0.01
<i>BACILLUS SUBTILUS</i>	Insecticide	680.6	0.004	17.7	0				
MCPB	Herbicide	672.0	0.004	396.0	0.003	1 717.5	0.02	3 271.5	0.04
SILOXYLATED POLYETHER	Adjuvant	662.7	0.004	1 690.2	0.01	1 130.9	0.01		
MALEIC HYDRAZIDE	Growth Regulator	658.3	0.004	867.8	0.007	1 952.7	0.02	551.7	0.01
CALCIUM POLYSULPHIDE	Fungicide	653.8	0.004	564.6	0.005	364.8	0	224.0	0
DICHLORBENIL	Herbicide	617.6	0.004	572.3	0.005	684.7	0.01	728.2	0.01
PROPYZAMIDE	Herbicide	617.3	0.004	475.7	0.004	179.4	0	272.0	0
NALED	Insecticide	578.1	0.004	823.0	0.007	972.6	0.01	1 257.9	0.01
BORAX	Insecticide	570.4	0.004	291.8	0.002	168.2	0	218.8	0
FLUMIOXAZIN	Herbicide	548.1	0.004						
SAFER'S INSECTICIDAL SOAP	Insecticide	479.8	0.003	902.0	0.007	1 040.2	0.01	1 941.6	0.02
DIFLUFENZOPYR-SODIUM	Herbicide	474.0	0.003						
CHLORMEQUAT	Growth Regulator	472.9	0.003	54.3	0	89.7	0	62.3	0
SPIROMESIFEN	Insecticide	458.4	0.003	1.7	0				

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
SOAP	Insecticide	452.4	0.003	1 331.8	0.01	947.2	0.01	1 211.1	0.01
ASPHALT SOLIDS	Fungicide	429.6	0.003	614.7	0.005	591.9	0.01	1 387.5	0.01
COPPER SULPHATE	Fungicide	422.0	0.003	23.7	0	672.1	0.01	316.1	0
BORACIC ACID	Insecticide	403.8	0.003	135.8	0.001	41.6	0	322.7	0
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insecticide	359.5	0.002	154.8	0.001	33.4	0	144.5	0
MANDIPROPAMID	Fungicide	344.4	0.002						
ENDOSULFAN	Insecticide	328.0	0.002	294.9	0.002	5 229.7	0.05	761.1	0.01
COPPER NAPHTHENATE	Anti-microbial	306.4	0.002	404.6	0.003	59.8	0	123.2	0
FENAMIDONE	Fungicide	298.2	0.002	5.0	0				
CHLORANTRANILIPROLE	Insecticide	288.3	0.002						
SILICON DIOXIDE FRESH WATER FOSSILS	Insecticide	280.0	0.002	29.0	0				
TRIETHANOLAMINE SALTS OF FATTY ACIDS	Insecticide	278.6	0.002						
S-METOLACHLOR	Herbicide	262.3	0.002	830.9	0.007	3 278.9	0.04		
TRIBASIC COPPER SULPHATE	Fungicide	249.7	0.002	375.9	0.003	130.9	0	159.6	0
SODIUM HYPOCHLORITE	Fungicide	243.5	0.002						
NAPROPAMIDE	Herbicide	214.2	0.001	211.9	0.002	159.1	0	294.6	0
SURFACTANT MIXTURE	Adjuvant	209.3	0.001	533.8	0.004				
DICHLORVOS	Insecticide	209.1	0.001	254.6	0.002	193.5	0	335.2	0
SPIROTETRAMAT	Insecticide	199.7	0.001	10.3	0				
<i>BACILLUS SUBTILIS (MB1600)</i>	Insecticide	189.7	0.001						
FERROUS SULFATE	Herbicide	180.2	0.001	7 846.5	0.06	1 593.4	0.02	1 818.7	0.02
STRYCHNINE	Rodenticide	168.6	0.001	595.5	0.005	244.8	0	163.2	0
CYAZOFAMID	Herbicide	161.2	0.001						
ZINC NAPHTHENATE	Anti-microbial	146.1	0.001	153.5	0.001	23.6	0	40.0	0

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
PYRETHRINS	Insecticide	133.6	0.0	240.0	0.002	220.9	0	178.2	0
THIABENDAZOLE	Fungicide	128.0	0.0	412.5	0.003	1 388.8	0.01	3 187.2	0.03
PARADICHLOROBENZENE	Insecticide	122.3	0.0	508.5	0.004	13.9	0	65.3	0
PYRIMETHANIL	Fungicide	120.0	0.0						
TRINEXAPAC-ETHYL	Growth Regulator	112.2	0.0	77.7	0.001	44.8	0		
FLUOPICOLIDE	Insecticide	112.1	0.0						
BUTOXPOLYPROPYLENE GLYCOL	Insecticide	110.1	0.0	4 161.6	0.03	370.2	0	2.3	0
HYDROGEN PEROXIDE	Insecticide	107.3	0.0			996.8	0.01		
RIMSULFURON	Herbicide	98.2	0.0	208.4	0.002	219.1	0	63.2	0
FOSETYL-AL	Fungicide	89.1	0.0	466.5	0.004	351.8	0	166.3	0
CYFLUTHRIN	Insecticide	89.0	0.0	351.6	0.003	92.3	0	1.3	0
N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	Anti-microbial	85.2	0.0	148.0	0.001	163.4	0	63.7	0
FERRIC SODIUM EDTA	Insecticide	82.9	0.0	28.1	0				
ALUMINUM PHOSPHIDE	Insecticide	79.9	0.0	569.3	0.005	269.6	0	2 215.7	0.02
ETHAMETSULFURON-METHYL	Herbicide	77.1	0.0	238.0	0.002	844.4	0.01	4 636.4	0.05
ACEPHATE	Insecticide	76.5	0.0	376.9	0.003	383.6	0	257.6	0
TETRAMETHRIN	Insecticide	74.2	0.0	18.4	0	20.3	0	14.2	0
DIDECYL DIMETHYL AMMONIUM CHLORIDE	Anti-microbial	73.5	0.0	106.5	0.001	167.4	0	120.6	0
D-TRANS ALLETHRIN	Insecticide	72.2	0.0	25.2	0	320.6	0	20.7	0
OXYFLUORFEN	Herbicide	69.0	0.0	89.0	0.001	46.0	0	27.4	0
CAPTAN	Fungicide	64.8	0.0	429.8	0.003	439.4	0	286.8	0
TOPRAMEZONE	Herbicide	59.9	0.0						
DAMINOZIDE	Growth Regulator	54.8	0.0	57.8	0	119.9	0	147.5	0
ACETAMIPRID	Insecticide	53.3	0.0	414.6	0.003				

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
D-PHENOTHRIN	Insecticide	50.8	0.0	14.8	0	6.8	0		
PYMETROZINE	Insecticide	50.4	0.0	55.5	0	95.0	0		
METALDEHYDE	Insecticide	48.9	0.0	105.5	0.001	101.3	0	476.5	0.01
PROPOXUR	Insecticide	48.1	0.0	41.3	0	107.2	0	170.0	0
OXAMYL	Insecticide	48.0	0.0	2.4	0	2.4	0	9.6	0
NATURAL GUM RESINS	Insecticide	41.9	0.0	32.3	0	0.7	0	9.0	0
P-MENTHANE-3, 8-DIOL	Insecticide	39.5	0.0	1.3	0	22.7	0		
POTASSIUM MONOPERSULPHATE	Anti-microbial	34.2	0.0	20.3	0	59.9	0	15.0	0
FOLPET	Insecticide	33.8	0.0	35.9	0	55.4	0	54.8	0
POLYMERIZED BUTENES	Vertebrate	31.9	0.0			21.7	0	92.9	0
ZOXAMIDE	Fungicide	31.6	0.0						
MYCLOBUTANIL	Fungicide	31.6	0.0	16.7	0	162.6	0	16.8	0
ZINEB	Fungicide	31.2	0.0	51.5	0	99.5	0	491.7	0.01
<i>BACILLUS THURINGIENSIS SSP KURSTAKI</i>	Insecticide	30.2	0.0	184.5	0.001	35.8	0	775.2	0.01
CHLORSULFURON	Herbicide	28.5	0.0	225.8	0.002	98.6	0	66.7	0
NICOSULFURON	Herbicide	27.9	0.0	126.7	0.001	140.1	0		
PYRAZON	Herbicide	27.1	0.0	72.2	0.001	338.0	0	1 204.9	0.01
BIFENAZATE	Insecticide	25.9	0.0	12.6	0				
SPINOSAD FACTOR A PLUS	Insecticide	25.4	0.0	18.7	0	1.9	0		
CUPROUS OXIDE (COPPER AS ELEMENTAL)	Preservative	25.4	0.0						
FLONICAMID	Insecticide	24.1	0.0						
EXTRACT OF <i>REYNOUTRIA SACHALINENSIS</i>	Fungicide	24.0	0.0						
D-CIS, TRANS ALLETHRIN	Insecticide	23.3	0.0	15.1	0	5.7	0	1.7	0
FERRIC PHOSPHATE	Insecticide	23.1	0.0	28.8	0	11.3	0		
POTASSIUM BICARBONATE	Fungicide	21.2	0.0						

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
<i>CONIOTHYRIUM MINITANS STRAIN CON/M/91-08</i>	Fungicide	19.1	0.0						
MANEB	Fungicide	17.4	0.0	1 521.5	0.01	3 346.4	0.04	8 462.0	0.09
ETRIDIAZOLE	Herbicide	16.8	0.0	54.9	0	122.1	0	210.6	0
OIL OF BLACK PEPPER	Vertebrate	13.6	0.0	27.7	0	16.5	0	12.0	0
FISH MEAL MIXTURE	Vertebrate	12.5	0.0						
DESMEDIPHAM	Herbicide	12.2	0.0	645.2	0.005	1 348.5	0.01	2 334.8	0.03
PHENMEDIPHAM	Herbicide	12.2	0.0	434.1	0.003	1 348.5	0.01	2 330.3	0.03
FENBUTATIN OXIDE	Insecticide	12.0	0.0	8.6	0	22.1	0	12.4	0
FENHEXAMID	Fungicide	12.0	0.0	14.3	0	2.5	0		
OXADIAZON	Herbicide	11.8	0.0	27.2	0	19.9	0	41.2	0
ROTENONE	Herbicide	11.1	0.0	49.7	0	61.7	0	180.0	0
GARLIC POWDER	Fungicide	10.0	0.0						
DI-N-PROPYL ISOCINCHOMERONATE	Insecticide	9.8	0.0	144.9	0.001	5.8	0	6.4	0
TEBUFENOZIDE	Insecticide	9.1	0.0	15.4	0	8.6	0		
CYPERMETHRIN	Insecticide	8.3	0.0	30.9	0	26.1	0	439.6	0
ACEQUINOCYL	Insecticide	8.2	0.0	3.5	0				
METHOMYL	Insecticide	8.1	0.0	54.8	0	436.8	0	434.5	0
PROPETAMPHOS	Insecticide	6.5	0.0	18.9	0	0.3	0		
FLUAZIFOP-P-BUTYL	Herbicide	6.0	0.0	1 830.8	0.01	5 808.5	0.06	12 914.0	0.1
PYRIDABEN	Insecticide	5.5	0.0	350.6	0.003	23.5	0	17.1	0
<i>BACILLUS FIRMUS I-1582</i>	Insecticide	5.3	0.0						
FAMOXADONE	Fungicide	5.1	0.0						
GARLIC OIL	Vertebrate	4.8	0.0						
BISPYRIBAC	Herbicide	4.5	0	0.5	0				
TRIFLUSULFURON METHYL	Herbicide	4.4	0.0	75.1	0.001	81.8	0		
COAL TAR OILS	Anti-microbial	4.3	0.0					1.2	0

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CYROMAZINE	Insecticide	4.1	0.0	2.7	0	9.8	0		
PUTRESCENT WHOLE EGG SOLIDS	Vertebrate	3.8	0.0	11.3	0			7.4	0
<i>BEAUVERIA BASSIANA STRAIN GHA</i>	Insecticide	3.7	0.0						
DRIED WHOLE EGGS	Vertebrate	3.6	0.0						
<i>PAECILOMYCES FUMOSOROSEUS STRAIN FE 9901</i>	Insecticide	3.4	0.0						
<i>TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2</i>	Fungicide	3.4	0.0						
COPPER OXYCHLORIDE	Fungicide	3.0	0.0	144.7	0.001	649.5	0.01	220.2	0
LACTIC ACID	Fungicide	3.0	0.0						
METHYL NONYL KETONE	Vertebrate	3.0	0.0	24.1	0	27.5	0	50.0	0
FERBAM	Herbicide	2.8	0.0	80.1	0.001	95.1	0	77.6	0
ABAMECTIN	Insecticide	2.6	0.0	2.9	0	6.7	0	3.6	0
RESMETHRIN	Insecticide	2.3	0.0	134.0	0.001	17.5	0	2.4	0
<i>STREPTOMYCES LYDICUS</i>	Fungicide	2.2	0.0	0.02	0				
DODEMORPH-ACETATE	Fungicide	2.0	0.0	3.6	0	42.8	0	55.2	0
DIPHACINONE	Rodenticide	1.7	0.0	0.9	0	0.4	0	0.4	0
KINOPRENE	Insecticide	1.6	0.0	2.5	0	9.9	0	33.6	0
CITRIC ACID	Anti-microbial	1.5	0.0						
PIPERINE	Rodenticide	1.5	0.0	1.0	0	0.6	0	0.4	0
MEAT MEAL MIXTURE	Vertebrate	1.4	0.0						
WINTERGREEN OIL	Vertebrate	1.4	0.0						
1-OCTEN-3-OL	Insecticide	1.4	0.0	1.6	0				
MEFLUTHRIN	Insecticide	1.4	0.0						
COAL TAR ACIDS	Anti-microbial	1.3	0.0					0.3	0
STREPTOMYCIN	Fungicide	1.3	0.0			1.0	0	2.1	0
WARFARIN	Rodenticide	1.0	0.0	3.8	0	2.0	0	1.8	0
Z-9-TRICOSENE	Insecticide	1.0	0.0	1 097.3	0.009	0.2	0	0.6	0

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DIMETHOMORPH	Fungicide	0.9	0.0	1.8	0	9.9	0	72.9	0
TRIASULFURON	Herbicide	0.8	0.0	45.5	0	190.3	0	505.0	0.01
BROMADIOLONE	Rodenticide	0.8	0.0	5.9	0	1.2	0	1.2	0
PHOSALONE	Insecticide	0.7	0.0	21.4	0	23.5	0	5.6	0
HYDRAMETHYLNON	Insecticide	0.7	0.0	0.9	0	20.4	0	9.2	0
FISH OIL MIXTURE	Vertebrate	0.6	0.0						
TEFLUTHRIN	Insecticide	0.6	0.0						
CASTOR OIL	Vertebrate	0.6	0.0						
PYRIPROXYFEN	Insecticide	0.5	0.0	0.9	0				
PACLOBUTRAZOL	Growth Regulator	0.5	0.0	3.0	0	0.2	0		
CHLOROPHACINONE	Rodenticide	0.4	0.0	23.7	0	1.7	0	1.8	0
DIFLUBENZURON	Insecticide	0.4	0.0	2.3	0	2.6	0		
<i>SCLEROTINIA MINOR IMI 3144141</i>	Herbicide	0.4	0.0						
BRONOPOL	Preservative	0.3	0.0	276.4	0.002	192.1	0		
BRODIFACOUM	Rodenticide	0.3	0.0	2.3	0	0.08	0	0.1	0
CLOFENTEZINE	Insecticide	0.2	0.0						
1,2-BENZISOTHIAZOLIN-3-ONE	Preservative	0.2	0.0						
METHOPRENE	Insecticide	0.2	0.0	174.1	0.001	6.7	0		
<i>GLIOCLADIUM CATENULATUM</i>	Fungicide	0.2	0.0	3.6	0				
CAPSAICIN	Vertebrate	0.2	0.0	0.2	0	0.1	0	0.1	0
<i>METARHIZIUM ANISOPLIAE (STRAIN F52)</i>	Insecticide	0.1	0.0						
SULFAQUINOXALINE	Rodenticide	0.1	0.0	0.4	0	0.4	0	1.4	0
BROMETHALIN	Rodenticide	0.06	0.0	0.2	0				
DIFETHIALONE	Rodenticide	0.04	0.0	0.2	0	0.06	0		
GIBBERELIC ACID	Growth Regulator	0.03	0.0	0.004	0	0.06	0	0.6	0
4-AMINOPYRIDINE	Rodenticide	0.03	0.0	0.4	0	0.2	0	1.5	0

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
<i>STREPTOMYCES GRISEOVIRIDIS</i>	Fungicide	0.03	0.0	0.008	0	0.04	0		
6-BENZYLAMINOPURINE	Growth Regulator	0.03	0.0			0.04	0		
UNICONAZOLE-P	Growth Regulator	0.02	0.0	0.02	0				
4-CPA	Growth Regulator	0.01	0.0	0.03	0			0.0015	0
ANCYMIDOL	Growth Regulator	0.001	0.0	0.03	0	0.03	0	0.1	0
QUINTOZENE	Fungicide			7 528.8	0.06	7 166.5	0.08	9 808.9	0.1
METHYL BROMIDE	Insecticide			6 106.3	0.05			1 850.9	0.02
VINCLOZOLIN	Fungicide			4 995.0	0.04	24 324.3	0.26	25 823.1	0.3
SIMAZINE	Herbicide			4 725.1	0.04	1 160.4	0.01	3 688.1	0.04
MECOPROP-D	Herbicide			3 271.0	0.03	26 080.4	0.28	27 264.1	0.3
TERBUFOS	Insecticide			1 797.0	0.01	2 893.0	0.03	6 697.8	0.07
SULPHUR (INSECTICIDE)	Insecticide			1 314.0	0.01	96.6	0	280.7	0
FORMALDEHYDE	Fungicide			464.0	0.004	17.8	0	96.2	0
DAZOMET	Soil fumigant			392.0	0.003	78.4	0	627.2	0.01
SODIUM ALPHA-OLEFIN SULFONATE	Adjuvant			291.0	0.002	299.1	0		
CARBOFURAN	Insecticide			265.0	0.002	676.1	0.01	6 413.4	0.07
METHAMIDOPHOS	Insecticide			230.4	0.002	1 008.0	0.01	19.2	0
OXYCARBOXIN	Fungicide			216.5	0.002	185.3	0	154.1	0
SOAP (HERBICIDAL)	Herbicide			188.4	0.002	42.4	0	10.4	0
<i>BACILLUS SPHAERICUS</i>	Insecticide			152.4	0.001				
AZINPHOS-METHYL	Insecticide			69.2	0.001	304.0	0	260.6	0
FATTY ACID	Herbicide			36.9	0	88.9	0	34.6	0
NICOTINE	Insecticide			36.4	0	27.2	0	27.5	0
WATER SOLUBLE DYES	Herbicide			35.1	0	48.7	0	5.1	0



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PROPANIL	Herbicide			32.0	0	96.0	0	1616.0	0.02
DICOFOL	Insecticide			27.0	0	84.0	0	423.6	0
ZINC PHOSPHIDE	Rodenticide			26.3	0	435.3	0	49.2	0
CHLORPROPHAM	Herbicide			20.2	0	120.4	0	679.8	0.01
OXINE BENZOATE	Fungicide			17.0	0	52.5	0	59.1	0
MESOTRIONE	Fungicide			9.2	0				
DICLOFOP-METHYL	Herbicide			5.7	0	715.2	0.01	3 239.9	0.03
PHOSMET	Insecticide			5.6	0	140.7	0	370.0	0
SULFOSULFURON	Herbicide			5.2	0	596.3	0.01		
AMMONIA	Rodenticide			2.3	0	0.4	0	1.1	0
ISOXABEN	Herbicide			1.4	0				
FENTHION	Insecticide			0.8	0	418.8	0	293.6	0
QUIZALOFOP-ETHYL	Herbicide			0.8	0	44.7	0	23 101.0	0.2
DENATONIUM BENZOATE	Vertebrate			0.5	0				
ARTIFICIAL ESSENTIAL OIL BLEND	Insecticide			0.4	0			2.1	0
SPINETORAM	Insecticide			0.2	0				
BENDIOCARB	Insecticide			0.2	0	36.0	0	59.3	0
D-CIS ALLETHRIN	Insecticide			0.03	0				
GERMAN COCKROACH EXTRACT	Insecticide			0.006	0				
CHOLECALCIFEROL	Rodenticide			0.003	0	0.01	0	0.1	0
AMMONIUM SULPHATE	Adjuvant					51 595.1	0.56	71 104.4	0.8
LINDANE	Insecticide					4 779.5	0.05	56 743.7	0.6
BENOMYL	Fungicide					3 275.0	0.04	14 616.3	0.2
TRICHLORFON	Insecticide					2 331.3	0.03	34 334.3	0.4
MUSTARD SEED POWDER ( <i>BRASSICA HIRTA</i> )	Rodenticide					471.3	0.01		
CYCLOATE	Herbicide					460.8	0	2 289.6	0.02

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METAM	Soil fumigant					415.1	0	410.7	0
CHLORONEB	Fungicide					233.9	0	559.3	0.01
PROPYZAMIDE	Herbicide					179.4	0	272.0	0
TALL OIL FATTY ACIDS	Adjuvant					176.0	0	1 470.4	0.02
PIRIMICARB	Insecticide					162.2	0	154.1	0
TRIADIMENOL	Fungicide					120.1	0	178.0	0
SODIUM METABORATE TETRAHYDRATE	Herbicide					117.5	0	1 616.3	0.02
BENSULIDE	Herbicide					95.9	0	212.6	0
PARAFORMALDEHYDE	Anti-microbial					68.3	0		
OCTYLPHENOXPOLYETHOXYETHANOL PHOSPHATE ESTER	Adjuvant					60.5	0		
CREOSOTE	Anti-microbial					58.1	0	805.2	0.01
SODIUM CHLORATE	Herbicide					53.0	0	729.1	0.01
CYANAZINE	Herbicide					45.0	0	3 891.6	0.04
ENDOTHALL	Herbicide					44.3	0	511.0	0.01
N-ALKYL POLYETHOXYETHANOL	Adjuvant					32.5	0	52.5	0
METHOXYCHLOR	Insecticide					24.7	0	109.9	0
1-BROMO-3-CHLORO-5,5- DIMETHYLHYDANTOIN	Anti-microbial					22.4	0	20.5	0
TRIFORINE	Fungicide					22.0	0	20.6	0
N-ALKYL DIETHANOLAMINE	Adjuvant					20.8	0	33.6	0
1,2-ETHANEDIOL	Adjuvant					17.4	0	87.0	0
PYRIDATE	Herbicide					12.6	0	486.0	0.01
METHIOCARB	Insecticide					12.1	0		
METOLACHLOR	Herbicide					11.2	0	4 297.9	0.05
COUMAPHOS	Insecticide					7.3	0	45.6	0
10,10'-OXYBIS(PHENOXARSINE)	Preservative					5.3	0		

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
ETHION	Insecticide					4.6	0	32.1	0
METHYL ANTHRANILATE	Vertebrate					4.1	0		
FENVALERATE	Fungicide					3.8	0	4.1	0
ALLETHRIN	Insecticide					2.8	0	2.0	0
FLAMPROP-M-METHYL	Herbicide					0.08	0	1 091.5	0.01
DITHIOPYR	Herbicide					0.05	0	2.1	0
FENOXAPROP-ETHYL	Herbicide					0.012	0	117.9	0
ERGOCALCIFEROL	Rodenticide					0.002	0	0.02	0
DISODIUM OCTABORATE TETRAHYDRATE	Anti-microbial							1 033.5	0.01
VEGETABLE OIL	Adjuvant							874.0	0.01
METHIDATHION	Insecticide							580.8	0.01
OXYDEMETON-METHYL	Insecticide							469.5	0.01
FONOFOS	Insecticide							330.0	0
COPPER TRIETHANOLAMINE COMPLEX	Anti-microbial							145.2	0
SULFOTEP	Insecticide							128.1	0
CHLORINE DIOXIDE FROM SODIUM CHLORITE	Anti-microbial							54.0	0
TETRACHLORVINPHOS	Insecticide							52.0	0
DIENOCHLOR	Insecticide							48.8	0
PARATHION	Insecticide							23.9	0
COPPER 8-QUINOLINOLATE	Anti-microbial							13.6	0
DODINE	Fungicide							13.0	0
CHLORTHAL	Herbicide							13.0	0
FLUAZIFOP-BUTYL	Herbicide							12.0	0
AMMONIUM SULPHAMATE	Herbicide							10.4	0
CHINOMETHIONAT	Insecticide							6.5	0

ACTIVE INGREDIENT NAME	Type of use	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
NAPTALAM	Herbicide							4.8	0
ARTIFICIAL ESSENTIAL OIL BLEND	Insecticide							4.5	0
ARSENIC (MSMA)	Herbicide							3.8	0
TEBUTHIURON	Herbicide							3.2	0
CHLORAMBEN	Herbicide							1.4	0
ANILAZINE	Fungicide							1.0	0
SODIUM FLUOSILICATE	Insecticide							1.0	0
DICHLONE	Fungicide							0.4	0
O-PHENYLPHENOL	Anti-microbial							0.2	0
TRIBUTYL TIN OXIDE	Anti-microbial							0.1	0
<b>TOTAL</b>		<b>15 231 071.5</b>	<b>100</b>	<b>12 476 095.8</b>	<b>100</b>	<b>9 264 487.7</b>	<b>100</b>	<b>9 273 494.1</b>	

Note: *Bacillus thuringiensis* active ingredient calculations in 1998 assumed that formulation consisted of 100% active ingredient, as guarantees on a percentage basis were not available. Guarantees on a percentage basis were obtained for these products in 2003. Recalculating the 1998 figures resulted in total active ingredient sold for *Bt kurstaki* and *Bt israelensis* of 775.2 and 294.2 kg ai, respectively.

#### Appendix 4. 2013 Pesticide Sales by Active Ingredient (kg) and River Basin

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
1,2-BENZISOTHAZOLIN-3-ONE		0.008							0.2					0.2
1-OCTEN-3-OL		0.1	0.002	0.03				0.6	0.5	0.02	0.05	0.01		1.4
2,4-D	7846	13482.0	67459.7	3696.7	54871.1		13459.2	73749.7	151449.2	31607.4	81408.3	10998.8	131143.1	641171.0
2,4-DB		137.5	231.3	36.0	568.8			450.0	1306.3	293.8	2012.5	6.3	81.3	5123.5
4-AMINOPYRIDINE								0.03						0.03
4-CPA	0.008	0.0002	0.00006		0.0006			0.002	0.0002	0.0001	0.0004		0.00001	0.01
6-BENZYLAMINOPURINE								0.009			0.018			0.03
ABAMECTIN	1.2	0.003	0.2	0.001	0.3			0.05	0.003	0.002	0.5	0.00005	0.3	2.6
ACEPHATE	4.5		1.1		15.8			20.3	14.6		6.8		13.5	76.5
ACEQUINOCYL	6.162										0.2		1.9	8.2
ACETAMIPRID	0.33768				14.0			25.3	9.4	0.2	4.1			53.3
ACETIC ACID	1754.8	92.7	43.8	17.2	1262.6			1441.1	81.7	95.9	169.7	1.3	79.9	5040.7
ACROLEIN					1238.0				9129.9					10367.8
ALCOHOLS, C9-11, ETHOXYLATED		4701.2	10499.0	588.8	1794.0			12907.6	6329.6	4456.9	9655.9		4452.8	55385.8
ALUMINUM PHOSPHIDE					2.2						77.7			79.9
AMINOPYRALID	1076.4	991.6	1531.8	272.7	545.4			3256.1	703.4	1748.5	1159.4	29.9	53.8	11369.2
AMITROLE		1143.5	1194.3		524.4			2.3	16.2	10344.2	341.9			13566.6
AMMONIUM SOAP OF FATTY ACID		25.4	24.9	4.0	242.5			335.6	38.9	24.5	62.5		24.8	783.0
ANCYMIDOL											0.001			0.001
ASPHALT SOLIDS		24.7	19.9	5.7	90.3			201.6	22.1	21.1	39.4		4.9	429.6
ATRAZINE		25.3	208.4		37.9			94.7	2425.0		124.7	94.7	37.9	3048.5
AZOXYSTROBIN	55.3	491.1	4322.8	250.4	2217.1			5589.2	3631.9	3473.2	3187.4	298.6	1450.2	24967.3
<i>BACILLUS FIRMUS I-1582</i>		0.4	0.09	0.002	0.01			0.4	3.5		0.4	0.02	0.4	5.3
<i>BACILLUS SUBTILIS (MB1600)</i>		15.2	19.6	4.8	9.3			39.2	26.2	49.2	20.8	1.2	4.3	189.7
<i>BACILLUS SUBTILIS (QT713)</i>	2.7	104.0	89.7	0.004	0.9			147.5	18.3	83.4	217.7		16.3	680.6

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
<i>BACILLUS THURINGIENSIS BERLINER SSP KURSTAKI</i>	5.7	7.4	0.1	0.009	1.2			0.6	0.8	10.9	0.9		2.7	30.2
<i>BACILLUS THURINGIENSIS, SEROTYPE H-14</i>	2.5	0.6	0.9		56.5			1482.8	0.5	0.9	4.6	0.01	0.9	1550.2
<i>BEAUVERIA BASSIANA STRAIN GHA</i>	3.5				0.2									3.7
BENTAZON		1931.6	7409.0	88.0	3711.9		382.2	5005.0	29039.0	22393.8	12318.6	1847.2	33230.8	117357.2
BIFENAZATE	15.4		0.2		0.4			0.4			0.6		8.8	25.9
BISPYRIBAC	0.9				1.9			1.7						4.5
BORACIC ACID	96.7	9.3	5.7		199.1			74.1	3.8	5.3	8.7	0.5	0.7	403.8
BORAX	315.1	11.1	8.1	3.0	101.3			80.4	12.5	10.4	20.8	0.2	7.5	570.4
BOSCALID	7.8	2036.1	7313.5	398.4	1829.8			5458.6	6949.6	1178.7	4153.2	1404.5	5276.5	36006.9
BRODIFACOU		0.02	0.03	0.0002	0.03			0.06	0.05	0.02	0.07	0.005	0.01	0.3
BROMACIL	1680.0	386.9	114.9	17.0	27.9			790.0	675.0	89.6	102.1	484.8	117.3	4485.6
BROMADIOLONE	0.00003	0.04	0.07	0.01	0.1			0.2	0.06	0.06	0.1	0.02	0.1	0.8
BROMETHALIN		0.004	0.01	0.001	0.007			0.008	0.02	0.001	0.01		0.004	0.06
BROMOXYNIL		5693.2	35390.8	1586.7	26376.6		6432.1	30420.0	64593.3	31308.1	64907.8	9229.5	39684.9	315622.8
BRONOPOL		0.04	0.02		0.004			0.03		0.03	0.2			0.3
BUTOXPOLYPROPYLENE GLYCOL		5.9	4.2	4.5	19.5			33.5	7.0	24.2	9.5	0.4	1.5	110.1
CALCIUM POLYSULPHIDE	367.9	5.1	4.6	0.2	95.0			146.7	5.8	8.1	3.7		16.8	653.8
CAPSAICIN (OLEORESIN CAPSICUM)	0.01	0.01	0.01	0.001	0.1			0.04	0.01	0.01	0.01	0.0004	0.0	0.2
CAPTAN	6.3	0.2	8.2		24.9			4.4	0.1	8.2	12.1	0.03	0.4	64.8
CARBARYL	756.6	322.8	225.5	21.6	630.4			1015.8	300.6	1142.2	360.2	10.1	133.2	4919.1
CARBATHIIN		307.2	1814.9	95.3	1431.3		272.7	3269.4	3694.9	3478.4	2621.3	350.7	1783.6	19119.5
CARFENTRAZONE-ETHYL		81.6	473.0	10.7	46.2		8.6	480.3	265.0	100.1	192.5	85.2	476.3	2219.4
CASTOR OIL		0.04			0.4			0.01	0.06		0.02		0.1	0.6
CELLULOSE (FROM POWDERED CORN COBS)	5465.9	80.4	39.2	24.0	1399.3	1.539		2152.0	120.1	96.3	136.5		81.7	9596.9
CHLORANTRANILIPROLE	3.8		27.6					90.0	166.1				0.8	288.3

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
CHLORMEQUAT	21.6		4.6		2.8			157.3			285.2		1.4	472.9
CHLOROPHACINONE	0.02	0.007	0.003	0.01	0.04			0.05	0.3	0.003	0.01	0.00003	0.004	0.4
CHLOROTHALONIL	4377.8	713.2	3091.7	242.4	12171.9			5077.0	22674.3	72.7	646.8		16299.0	65366.9
CHLORPYRIFOS	782.4	2072.3	10601.2		1952.6			4095.7	8502.7	1032.0	1387.2	281.3	5819.0	36526.5
CHLORSULFURON	0.8	3.0	5.6					18.8	0.4					28.5
CITRIC ACID	1.5													1.5
CLETHODIM		1398.2	6643.1	128.2	1365.8		44.6	6916.2	3552.5	4850.3	3927.8	324.0	990.7	30141.6
CLODINAFOP-PROPARGYL	1861.8	293.4	2548.1	54.0	528.8		414.7	2478.6	3016.3	2657.3	3781.4	7616.6	5079.6	30330.7
CLOFENTEZINE								0.2						0.2
CLOPYRALID	8.0	1879.6	13703.6	247.1	4860.3		80.4	16512.3	10420.6	7897.9	11090.9	1562.5	1088.0	69351.3
CLOTHIANIDIN		1416.9	4643.5	104.6	1183.5			7010.7	3173.2	5786.8	3633.4	308.8	763.2	28024.6
COAL TAR ACIDS		1.2								0.09				1.3
COAL TAR OILS		4.0								0.3				4.3
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08								7.4	1.1	7.4	3.2			19.1
COPPER (CUPRIC) HYDROXIDE	21.5		2.4						2222.1		5.0		3680.0	5931.0
COPPER NAPHTHENATE		54.3	25.6	10.8	26.0		0.5	78.0	16.3	33.5	48.3		13.2	306.4
COPPER OXYCHLORIDE					2.0						1.0			3.0
COPPER SULPHATE	1.2	4.2	12.5	1.0	5.3			1.1	248.2		0.06		148.5	422.0
COPPER SULPHATE TRIBASIC	115.8	7.0	11.1	0.1	62.8			32.0	7.8	2.5	3.9	0.4	6.3	249.7
CORN GLUTEN MEAL		23321.9	10566.5	6618.9	105893.5			114479.7	13229.0	15659.1	25546.9	80.5	15571.4	330967.4
CUPROUS OXIDE (COPPER AS ELEMENTAL)		4.1						11.7	6.4	0.4	2.7			25.4
CYAZOFAMID								3.9	157.3					161.2
CYFLUTHRIN	4.5	1.8	26.2	0.08	1.8			10.4	21.9	1.2	16.2	2.5	2.4	89.0
CYHALOTHRIN-LAMBDA		98.4	279.2	44.2	397.0		13.6	398.8	1965.3	2367.1	253.1	15.9	337.9	6170.5
CYMOXANIL								21.6	1011.7	3.2	5.1			1041.6
CYPERMETHRIN								3.7	3.0		1.6			8.3

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
CYPRODINIL	31.6	1295.1	6271.5		2437.4			9370.5	8632.9	4959.6	3024.4	586.4	562.8	37172.2
CYROMAZINE	2.0				0.4						1.7			4.1
DAMINOZIDE	9.8	0.4			10.2			14.0			20.4			54.8
D-CIS, TRANS ALLETHRIN	0.2	4.2	1.7	0.1	3.3			5.3	1.7	2.2	3.4	0.5	0.6	23.3
DEET	179.5	546.4	261.5	94.2	1300.3	0.5	2.2	1980.0	241.6	490.6	632.3	35.6	136.6	5901.4
DELTAMETHRIN	0.3	81.7	358.4	44.5	36.7			293.4	335.2	435.8	180.5	57.1	73.0	1896.7
DESMEDIPHAM								1.5					10.7	12.2
DIAZINON		10.1	23.3		276.0			356.1	85.2	35.0	177.0	2.3	21.8	986.6
DICAMBA	1573.4	1068.1	1973.9	335.4	3181.1		1584.0	11542.1	7872.4	1656.3	10550.4	479.9	12302.7	54119.6
DICHLOBENIL		43.0	31.1		47.3			115.3	228.5	21.8	101.3	1.8	27.5	617.6
DICHLORPROP			159.9		1218.6		220.5	43.3	1141.5	3.0	131.4		4930.5	7848.8
DICHLORVOS	17.2	12.2	11.3	3.5	43.6			60.7	11.5	6.7	38.0	0.4	4.1	209.1
DIDECYL DIMETHYL AMMONIUM CHLORIDE	3.5		16.0		3.6			31.5	6.9	9.0	3.0			73.5
DIFENOCONAZOLE		572.0	2218.2	13.1	1277.4		106.1	2470.1	3470.1	1538.4	1574.6	309.6	1394.8	14944.4
DIFENZOQUAT		68.0	69.2					778.2	1385.2	566.4	1693.6		20.0	4580.6
DIFETHIALONE		0.005	0.006	0.0004	0.003			0.01	0.004	0.003	0.005	0.002	0.002	0.04
DIFLUBENZURON					0.3								0.1	0.4
DIFLUFENZOPYR		0.5	23.2		30.2		3.7	56.5	369.9	12.9	61.6	4.6	615.7	1178.7
DIFLUFENZOPYR-SODIUM	22.4	5.4						272.0	5.4	57.1	2.7		108.8	474.0
DIMETHOATE		28.8	9.6		123.8			9.6	211.3	134.4	67.2		705.6	1290.3
DIMETHOMORPH											0.9			0.9
DI-N-PROPYL ISOCINCHOMERONATE		0.5	0.3	0.4	1.5			4.2	0.5	1.5	0.7	0.02	0.1	9.8
DIPHACINONE	0.05	0.01	0.02	0.0002	0.03			0.4	0.1	0.02	0.08	0.2	0.7	1.7
DIQUAT		2084.4	4564.5	232.8	3598.8			5633.5	9282.2	11807.2	8263.9	537.6	15199.5	61204.4
DIURON	5977.4	988.3	64.0	120.0				11622.4	576.0	376.0	552.0	480.0	888.0	21644.1
DODEMORPH-ACETATE	0.8				1.2									2.0
D-PHENOTHRIN	16.5	1.0	0.6	0.3	16.4			10.2	1.3	0.9	2.6	0.002	1.1	50.8



Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
DRIED BLOOD	3.3	39.8	63.5	1.5	315.8			61.5	34.1	38.5	168.2		32.8	759.0
DRIED WHOLE EGGS		0.3			2.3			0.04	0.4		0.08		0.6	3.6
D-TRANS ALLETHRIN	14.2	2.4	9.2	0.5	13.0		0.06	17.2	3.0	2.7	6.7	1.9	1.3	72.2
ENDOSULFAN								72.0	252.0		4.0			328.0
EPTC			8.0		8.0				5608.0		64.0			5688.0
ETHALFLURALIN		980.4	21832.3		3111.0		366.4	3647.0	25839.4	768.1	12189.8	415.8	17978.4	87128.4
ETHAMETSULFURON-METHYL		0.7	5.3		0.5		0.5	5.4	25.4	20.4	5.9	3.8	9.1	77.1
ETHEPHON			472.8		204.0				736.8		549.8		1173.1	3136.6
ETHOFUMESATE									816.0				48.0	864.0
ETRIDIAZOLE	2.1		0.2		10.5			1.5	0.0001	0.0003	1.6		0.8	16.8
EXTRACT OF REYNOU TRIA SACHALINENSIS	24.0													24.0
FAMOXADONE											5.1			5.1
FENAMIDONE			1.0						297.2					298.2
FENBUTATIN OXIDE	2.3				8.6			1.1						12.0
FENHEXAMID			0.5							9.0	1.0		1.5	12.0
FENOXAPROP-P-ETHYL	2899.1	2124.0	5429.1	810.8	2423.7		3095.3	7248.9	7551.7	5464.8	8752.4	1558.2	6938.0	54295.9
FERBAM		0.2	0.08		0.08			2.3			0.2			2.8
FERRIC PHOSPHATE		0.8	0.8	0.05	6.1			12.1	0.6	1.0	1.5	0.06	0.2	23.1
FERRIC SODIUM EDTA		3.2	1.3	0.5	30.5			35.7	2.3	4.0	4.6		0.8	82.9
FERROUS SULFATE		21.2	2.8	3.3	52.6			70.2	4.1	10.5	13.8		1.9	180.2
FISH MEAL MIXTURE		1.0			7.7			0.1	1.2		0.4		2.1	12.5
FISH OIL MIXTURE		0.05			0.4			0.01	0.06		0.02		0.1	0.6
FLONICAMID	13.3		3.4		0.3						1.0		6.1	24.1
FLORASULAM		631.9	3098.7	70.7	1344.6		36.8	4061.7	1360.2	1826.7	2673.7	220.0	239.3	15564.3
FLUAZIFOP-P-BUTYL					1.0					5.0				6.0
FLUAZINAM								32.0	1121.3				856.0	2009.3
FLUCARBAZONE SODIUM		6531.1	3261.0	29.2	261.8		3.1	3779.7	1364.1	1510.9	1285.2	96.0	187.5	18309.5

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
FLUDIOXONIL	147.0	884.7	4392.3	1.4	1986.2		1.1	6391.5	6215.0	3420.9	2103.9	424.7	672.1	26640.8
FLUMIOXAZIN	134.6	65.0			17.7			154.2	95.2	2.5	43.9		35.2	548.1
FLUOPICOLIDE									112.1					112.1
FLUOPYRAM		297.7	36.6					646.6	573.4	331.8	28.1		261.1	2175.3
FLUROXYPYR	181.3	3442.0	28774.3	296.2	14044.3		1381.0	28002.7	32197.6	10192.3	22681.5	1795.5	15125.8	158114.3
FLUXAPYROXAD		247.2	1916.4		631.2			746.4	1989.6	981.6	916.8	326.4	1778.4	9534.0
FOLPET	7.7	0.8	1.1	0.2	9.4			10.1	1.7	0.4	1.6	0.02	0.7	33.8
FOMESAFEN			505.5					728.8	320.7	884.5	147.0			2586.4
FOSETYL-AL					32.5			40.0			16.6			89.1
GARLIC OIL		0.004			0.03			0.02	0.005	0.02	0.002		4.7	4.8
GARLIC POWDER	3.0												7.0	10.0
GIBBERELIC ACID			0.002		0.002			0.01			0.02			0.03
<i>GLIOCLADIUM CATENULATUM</i>									0.04	0.04	0.1			0.2
GLUFOSINATE AMMONIUM	1765.6	36986.9	136950.5	3739.5	26119.4			155268.6	52401.7	168413.2	91361.1	5646.1	15843.5	694496.1
GLYPHOSATE	407755.4	336697.3	1321275.7	72995.0	451069.2		35037.9	1482551.5	1055286.0	1100247.2	1323119.7	151997.7	989271.6	8726904.1
HEXAZINONE			24.0		76.5				1854.0	136.5	1086.0			3177.0
HYDRAMETHYLNON								0.5					0.2	0.7
HYDROGEN PEROXIDE	5.1		2.6		69.0			5.1	2.6	5.1	17.9			107.3
IMAZAMETHABENZ		2345.0	1133.2	956.6	2556.4			6150.3	437.4	4226.6	4789.7	103.7	142.6	22841.4
IMAZAMOX		292.6	1782.5	38.2	489.0		22.2	1843.9	2126.4	1208.6	1517.0	1241.4	1881.7	12443.4
IMAZETHAPYR	32.5	56.2	504.3	4.4	236.2		4.4	333.0	568.2	113.6	455.1	102.5	536.6	2946.9
IMAZYPYR	437.8	853.8	450.4		69.1			3122.3	99.2	873.2	607.6	452.8	57.6	7023.7
IMIDACLOPRID	5.3	46.6	1447.0		579.7		28.2	843.9	3119.4	509.9	2044.1	20.2	951.3	9595.5
IPCONAZOLE		7.5	52.6	0.001	0.9			2.0	221.6	96.8	426.6	0.008	82.2	890.2
IPRODIONE	22.2	8425.1	8665.9	998.6	5273.8			20895.8	5483.3	3947.3	5538.9	2330.5	1021.2	62602.7
IRON FeHEDTA	5.7	49.4	22.0	12.0	464.2			584.7	39.6	59.7	80.4	0.05	33.3	1351.1
KINOPRENE	0.2				1.2								0.2	1.6
LACTIC ACID	3.0													3.0

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
LINURON		1160.8	1003.1	19.2	228.8			338.4	257.6	41.6	314.4	149.2	163.2	3676.3
LIQUID CORN GLUTEN	1630.9	26.9	6.0		339.4			146.7	75.9	9.0	12.0			2246.8
MALATHION	1161.4	547.1	523.2	87.1	829.1		72.9	1922.8	2006.1	791.2	1533.0	60.7	540.9	10075.5
MALEIC HYDRAZIDE									653.8		4.5			658.3
MANCOZEB	15.0		167.4		2355.0			516.2	13644.4	32.9	845.9		181.7	17758.5
MANDIPROPAMID		11.4							333.1					344.4
MANEB											17.4			17.4
MCPA	2210.0	47037.3	163423.6	6142.3	55018.5		483.1	215597.2	96494.5	142131.0	145521.3	21220.6	25153.9	920433.3
MCPB			42.0					41.3	3.8	393.8	191.3			672.0
MEAT MEAL MIXTURE		0.09			0.9			0.02	0.1		0.03		0.2	1.4
MECOPROP	112.6	1423.0	1559.7	426.0	6842.0		30.2	10833.1	2511.6	1992.9	3411.3	134.9	1538.4	30815.6
MEFLUTHRIN	0.09	0.02	0.007		0.0			0.9	0.004	0.0	0.4	0.002	0.003	1.4
METALAXYL		275.4	912.8	11.0	350.9		4.9	1062.9	762.0	562.9	1082.3	74.9	322.1	5422.2
METALAXYL-M	5.5	95.7	718.4	3.9	340.8		29.0	797.9	7195.6	467.1	544.5	74.6	737.3	11010.3
METALDEHYDE	40.2	0.04	0.2		4.4			3.4	0.4		0.1			48.9
<i>METARHIZIUM ANISOPLIAE (STRAIN F52)</i>	0.1													0.1
METCONAZOLE		313.6	4005.8	21.8	1816.1			2891.1	4693.7	627.1	2652.5	692.5	1923.0	19637.1
METHOMYL		0.7	0.7		0.3			1.9	0.6	0.2	2.0		1.8	8.1
METHOPRENE					0.2				0.03					0.2
METHYL NONYL KETONE		0.2	0.02		1.2			0.5	0.4	0.2	0.2	0.07	0.2	3.0
METHYLATED CANOLA OIL		8987.2	21306.6	110.3	7327.6			35539.7	6375.3	25096.7	26660.3	2969.9	275.7	134649.3
METIRAM									1188.0					1188.0
METRIBUZIN		110.6	146.3		22.5			341.6	2722.5	208.1	103.1			3654.8
METSULFURON-METHYL	160.0	151.0	383.8	37.4	96.3		0.2	592.2	152.1	288.9	322.9	33.1	32.9	2250.9
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	5004.2	45.7	36.9	6.2	5189.6			1035.7	31.7	21.6	397.1		50.9	11819.4
MONO- AND DIBASIC SODIUM, POTASSIUM, AND									4030.7					4030.7

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
AMMONIUM PHOSPHITES														
MYCLOBUTANIL	8.5	4.7			8.5			3.1			2.8		4.0	31.6
NALED	3.3								525.8		49.0			578.1
N-ALKYL (40% C12, 50% C14, 10% C16) DIMETHYL BENZYL AMMONIUM CHLORIDE	2.3		4.0					18.0	58.0					82.3
N-ALKYL (67% C12, 25% C14, 7% C16, 1% C18) DIMETHYL BENZYL AMMONIUM CHLORIDE	2.9													2.9
NAPHTHALENE		263.8	90.7	55.5	514.7	2.772		868.0	117.3	181.4	289.4	5.5	60.2	2449.3
NAPROPAMIDE			67.0		48.9			40.8	44.9	4.5	7.2		0.9	214.2
NATURAL GUM RESINS		0.5	2.6		26.8			6.7	1.8	2.3	1.3			41.9
NICOSULFURON			1.9					0.3	2.2		1.2		22.2	27.9
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	80.2	8.4	45.2	2.2	67.5			78.6	13.0	13.8	33.0	9.8	7.8	359.5
NONYLPHENOXYPOLYETH OXYETHANOL	18.0	2138.6	3787.2	772.8	2062.6			12116.6	7556.2	5017.2	3385.2	972.0	788.7	38615.1
OCTADEC-9-ENOIC ACID, METHYL ESTER	3417.7	1103.0	845.8	583.0	591.5			5955.2	911.6	2326.1	2020.3	40.0	351.5	18145.8
OCTYLPHENOXYPOLYETHO XYETHANOL	17.0	3.8	1045.2		107.7		18.9	226.8	87.9	169.8	688.6	52.9	1.9	2420.4
OIL OF BLACK PEPPER	1.3	0.9	0.7	0.08	4.3			3.0	0.9	0.7	1.1	0.05	0.4	13.6
OXADIAZON					10.9						0.9			11.8
OXAMYL									48.0					48.0
OXYFLUORFEN		69.0												69.0
PACLOBUTRAZOL	0.02				0.02			0.04	0.1		0.3			0.5
<i>PAECILOMYCES FUMOSOROSEUS STRAIN FE 9901</i>	0.7				0.2			0.3		0.2	1.8		0.3	3.4
PARADICHLOROBENZENE		32.5	4.5					25.2	11.1	26.9	19.4	2.8		122.3

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
PARAFFIN BASE MINERAL OIL (ADJUVANT)		298.0	6177.8	68.0	3653.2		40.0	5886.3	15379.0	2247.5	6951.8	1064.0	4007.1	45772.7
PARAFFIN BASE PETROLEUM OIL		2683.2	4284.0	62.4	2539.2		9.6	3790.2	9014.4	21518.4	11098.8	52.8	7135.2	62188.2
PARAQUAT		1.0	3.0		8.6			229.0	1096.0	6.0	63.0		243.0	1649.6
PENDIMETHALIN									883.8					883.8
PENFLUFEN		51.0	201.7	3.2	21.8			277.0	425.8	177.8	200.3	23.2	64.9	1446.8
PENTHIOPYRAD		1196.0	2346.0		206.0			3544.0	1291.3	768.0	2242.0	274.0	1312.0	13179.3
PERMETHRIN	289.2	92.6	57.1	7.2	484.8			301.3	77.0	82.6	67.9	9.1	40.2	1508.9
PETROLEUM HYDROCARBON BLEND		3078.0	29056.5	445.5	10419.0		3725.2	20642.7	43540.5	9500.1	28768.3	10131.5	55831.8	215138.9
PHENMEDIPHAM								1.5					10.7	12.2
PHORATE			87.0						12450.0		105.8			12642.8
PHOSALONE		0.06	0.02		0.02			0.6			0.04			0.7
PICLORAM	475.7	1580.0	2786.1	75.3	826.7			4419.9	1113.4	2980.8	2577.5	177.8	197.0	17209.9
PICOXYSTROBIN		230.4	1360.8		945.6			931.2	1591.7	67.2	931.2		1699.2	7757.3
PINOXADEN		3289.0	11064.1	21.0	5788.3		3.0	14143.6	8338.3	9529.1	12592.4	839.3	1334.6	66942.7
PIPERINE	0.05	0.1	0.1	0.01	0.5			0.4	0.09	0.09	0.1	0.003	0.03	1.5
PIPERONYL BUTOXIDE	59.7	42.3	116.5	8.4	98.6		0.2	404.2	950.2	45.4	73.0	2.1	23.7	1824.3
P-MENTHANE-3, 8-DIOL		4.0	1.7	0.8	11.4			14.6	2.0	1.6	2.7	0.04	0.7	39.5
POLYMERIZED BUTENES					20.7			8.6	2.6					31.9
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER		5243.4	21409.8	480.6	4992.3			20971.0	11939.4	13755.2	13789.8	1107.0	3569.4	97257.9
POTASSIUM BICARBONATE	21.2													21.2
POTASSIUM MONOPERSULPHATE	32.1				2.1									34.2
POTASSIUM SALTS OF FATTY ACIDS	10.1	31.7	16.2	3.0	207.7			330.0	38.2	29.4	61.3		31.4	759.0
PROMETRYNE									461.4				817.0	1278.4
PROPAMOCARB HYDROCHLORIDE	113.4		30.3		2.2				1295.1		5.8		63.5	1510.2

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
PROPETAMPHOS	5.4				0.5					0.5				6.5
PROPICONAZOLE	551.0	3740.2	39803.6	430.7	8142.6		774.5	15609.5	16474.1	7921.1	16561.4	1302.9	8028.4	119339.7
PROPOXUR	13.4	3.3	2.9	0.3	4.8		0.1	10.9	5.3	2.3	3.4	0.2	1.2	48.1
PROPYZAMIDE	6.0		61.4	40.0	18.0			140.0	89.4	88.0	151.5	3.4	19.6	617.3
PROTHIOCONAZOLE		6726.1	16440.1	472.5	3366.0			16060.8	11531.9	11852.1	12242.4	308.4	2608.7	81609.0
PUTRESCENT WHOLE EGG SOLIDS		0.9						1.9		0.9				3.8
PYMETROZINE	6.1	0.2			1.3			28.9	0.2	0.2			13.5	50.4
PYRACLOSTROBIN	5.7	1194.7	13220.4	238.5	5361.4		22.8	9662.3	11574.1	4406.6	9827.0	2420.2	5468.5	63402.0
PYRASULFOTOLE		922.7	4020.4	247.5	3283.6		267.2	3508.7	4124.4	4359.3	5989.0	444.4	1050.9	28218.1
PYRAZON											25.8		1.3	27.1
PYRETHRINS	9.6	19.0	6.3	1.4	18.8			34.1	15.9	12.5	11.8	0.3	3.9	133.6
PYRIDABEN					1.1						4.4			5.5
PYRIMETHANIL									115.2				4.8	120.0
PYRIPROXYFEN	0.3										0.2			0.5
PYROXSULAM		803.7	4082.2		1013.8		3.6	4102.2	2109.0	561.3	3616.1	23.5	2846.7	19162.1
QUINCLORAC		86.8	311.5					861.0		197.7	52.3			1509.3
QUIZALOFOP P-ETHYL		429.3	685.4	10.0	459.3		1.5	606.4	1442.3	4161.0	1775.8	8.4	1257.6	10837.2
RESMETHRIN	0.5	0.01	0.02		1.1			0.6	0.02	0.01	0.1		0.0	2.3
RIMSULFURON			0.2					15.2	80.3	0.5	1.4		0.5	98.2
ROTENONE	1.7	0.9	1.3	0.08	0.2			4.1	0.7	1.4	0.3	0.02	0.5	11.1
SAFER'S INSECTICIDAL SOAP		2.3	0.4		328.4			131.7	5.2	0.3	11.4		0.2	479.8
SAFULFENACIL		190.2	1335.2	14.2	324.3		14.8	724.3	1200.5	420.6	1042.5	341.5	1490.0	7098.2
<i>SCLEROTINIA MINOR IMI 3144141</i>				0.2	0.2									0.4
SEDAXANE		77.1	379.7	0.3	247.7		23.0	1161.5	673.2	252.4	277.3	7.6	295.1	3395.0
SETHOXYDIM		6.9	117.8		114.3			41.6	1777.5	4.3	31.2		48.5	2142.2
SILICA AEROGEL			1696.5	4.5	1543.5		202.5	850.1	4810.5	319.5	4018.5	36.0	695.4	14177.0
SILICON DIOXIDE FRESH		24.7	10.4	3.1	46.6			142.7	18.9	9.4	20.5		3.7	280.0

Active Names	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
WATER FOSSILS														
SILICON DIOXIDE SALT WATER FOSSILS	3169.2	459.8	509.4	114.4	3635.3		22.5	4496.4	1196.1	612.3	1254.5	6.6	828.7	16305.1
SILOXYLATED POLYETHER		121.6	12.2		24.3			24.3	273.6	206.7				662.7
SIMAZINE			4.8		8.9				2069.3		71.7			2154.8
S-METOLACHLOR									229.4		11.0		22.0	262.3
SOAP	33.8	2.0	1.2		224.4			156.4	10.3	7.3	6.2	0.08	10.7	452.4
SODIUM HYPOCHLORITE	243.5													243.5
SPINOSAD FACTOR A PLUS	4.3		0.5		13.0			0.5	0.7		4.3		2.2	25.4
SPIROMESIFEN	4.4				0.1				403.2	0.5	0.2		49.9	458.4
SPIROTETRAMAT	3.6		46.6					95.0	54.0		0.5			199.7
<i>STREPTOMYCES GRISEOVIRIDIS</i>	0.03													0.03
<i>STREPTOMYCES LYDICUS</i>	1.9				0.02				0.02				0.2	2.2
STREPTOMYCIN					1.0								0.3	1.3
STRYCHNINE		0.6	43.2	0.9	15.2			24.9	55.5		16.1	4.6	7.6	168.6
SULFAQUINOXALINE		0.007	0.02		0.006			0.03	0.01	0.01	0.007		0.006	0.1
SULFENTRAZONE			149.2		347.5		10.9	52.8	1640.9		374.8		1766.4	4342.4
SULPHUR (FUNGICIDE)	293.8	29.3	56.3	9.9	258.6			318.8	26.8	35.9	77.0	0.006	16.1	1122.4
SULPHUR (VERTEBRATE CONTROL)	200.0	25.6	23.6		248.5		0.9	106.6	60.2		37.0	0.9	23.0	726.4
SURFACTANT BLEND	21.6	5825.2	44701.5	570.0	14431.0		1935.5	33235.9	57782.7	34856.1	40921.2	9337.3	57296.2	300914.3
SURFACTANT MIXTURE		38.4	3.8		7.7			7.7	86.4	65.3				209.3
TALLOW FATTY ACID AMINE ETHOXYLATE		38.4	25.6					179.2	710.4	6.4	51.2		1255.7	2266.9
TEBUCONAZOLE		7264.2	25603.6	506.5	7288.5		114.2	32837.4	12452.3	7915.0	22259.0	1320.5	4005.6	121566.7
TEBUFENOZIDE	6.8												2.3	9.1
TEFLUTHRIN								0.6						0.6
TEPRALOXYDIM		125.8	1028.5		555.4		2.7	669.2	1227.2	240.7	968.7	215.8	852.0	5885.9
TERBACIL			1.6						134.4	3.2			595.2	734.4

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TETRAMETHRIN	22.5	1.4	1.0	0.4	25.5			14.8	2.0	1.5	3.6	0.02	1.6	74.2
THIABENDAZOLE		90.2		0.2	1.6						21.0	15.0	0.1	128.0
THIAMETHOXAM		1474.0	3718.8	217.6	1510.4		88.3	4333.6	5324.8	3954.9	2397.2	276.1	1696.7	24992.3
THIENCARBAZONE METHYL		3.9	142.3	1.2	62.4			68.2	74.3	144.8	207.5	9.5	50.8	765.0
THIFENSULFURON METHYL	134.7	637.3	1010.0	107.0	74.1			1646.8	568.6	915.3	627.0	169.1	448.4	6338.3
THIOPHANATE-METHYL	5.3	0.04	14.0		11.2			8.8	1869.1	0.1		0.02	0.2	1908.8
THIRAM	36.0	269.6	1904.6	85.6	1498.1		241.6	1267.1	4042.8	1372.4	2588.2	457.6	1366.0	15129.5
TOPRAMEZONE									59.9					59.9
TRALKOXYDIM		435.2	9487.4	67.2	4425.6		822.4	8859.2	16925.6	2881.6	9377.6	1536.0	2713.6	57531.4
TRIALATE		4118.0	115719.0		46527.8		3899.2	27929.6	56363.0	8136.1	98283.1	1911.8	4529.2	367416.9
TRIASULFURON			0.3									0.5		0.8
TRIBENURON METHYL	162.2	743.6	3427.5	81.5	526.9		1.3	2415.9	1294.7	1192.3	2078.1	320.8	933.8	13178.7
<i>TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2</i>	3.4													3.4
TRICLOPYR	9916.8	2629.8	2271.8	513.4	1494.7			12888.8	730.8	2372.2	200.4	271.8	151.0	33441.5
TRIETHANOLAMINE SALTS OF FATTY ACIDS	73.4	4.5	5.9	0.6	67.6			94.0	13.6	8.8	7.4		2.8	278.6
TRIFLOXYSTROBIN		132.5	809.1	6.4	303.1			945.7	528.4	443.7	682.7	64.6	527.7	4443.8
TRIFLURALIN		7.4	5853.6		2517.2			2389.6	779.3	17.7	6257.5	962.5	4987.2	23772.0
TRIFLUSULFURON METHYL									0.9				3.5	4.4
TRIGLYCERIDE ETHOXYLATE 10 POE		22.4	4321.6		91.2		317.3	2443.2	105.8	3004.8	1233.6	24860.8	237.0	36637.6
TRINEXAPAC-ETHYL	64.7				41.6			4.5	0.6	0.9				112.2
TRITICONAZOLE		72.8	362.0	44.6	157.8			484.2	289.5	69.0	278.4	34.1	103.5	1895.7
UNICONAZOLE-P	0.01										0.004			0.02
WARFARIN	0.04	0.07	0.1	0.01	0.1		0.006	0.3	0.09	0.08	0.09	0.001	0.02	1.0
WINTERGREEN OIL		0.1			0.8			0.02	0.1		0.05		0.2	1.4
Z-9-TRICOSENE		0.08	0.1	0.04	0.009			0.2	0.3	0.004	0.3		0.07	1.0
ZINC NAPHTHENATE		22.5	20.3	1.9	11.9			47.4	6.7	4.8	26.8		3.9	146.1



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ZINEB		2.2	1.9		1.5			10.8	4.0	1.5	4.9	1.1	3.3	31.2
ZOXAMIDE									31.6					31.6
Grand Total	<b>477866.7</b>	<b>591675.0</b>	<b>2331460.0</b>	<b>108629.8</b>	<b>978136.4</b>	<b>4.8</b>	<b>76183.2</b>	<b>2636786.6</b>	<b>2079193.8</b>	<b>1823996.1</b>	<b>2259426.1</b>	<b>290716.3</b>	<b>1577035.1</b>	<b>15231071.5</b>