Pesticide Sales in Alberta

Overview | 2018

Alberta

Overview of 2018 Pesticide Sales in Alberta

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EXECUTIVE SUMMARY

Alberta Environment and Parks undertook the collection, consolidation and analysis of pesticide sales data from pesticide vendors in Alberta for the 2018 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 policy and program assessment, as well as environmental monitoring programs. This project is an ongoing survey conducted every five years, with previous reporting undertaken for the years 1993, 1998, 2003, 2008 and 2013. 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, 2013 and 2018 reports also included individual active ingredient sales information as well as sales by chemical group.

Pesticide sales data for 2018 was requested from registered wholesale and retail pesticide vendors in Alberta in early 2019, under the authority of the *Environmental Protection and Enhancement Act* and supporting regulations. Approximately 85% compliance with the sales data request was obtained. A number of vendors (retail and wholesale) changed ownership or closed during 2018, which reduced the reporting compliance compared to previous years. Wholesale records of shipments to these vendors were utilized, where available, to replace actual sales data.

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®, 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 2018, a total of 16 744 639 kg of pesticide active ingredient (ai) was sold in, or shipped into Alberta. Pesticides sold into the Agriculture sector accounted for 95.8% of all pesticides sold, with the Commercial/Industrial sector accounting for 2.1% of sales,

and the Domestic sector accounting for 2.0% of sales. The types of pesticides sold were predominantly herbicides, at 82.2%. Adjuvants and surfactants made up the next largest category at 10.1%. Insecticides made up 1.9% of sales, while fungicides made up 5.8% of sales.

Of the chemical groups, the Phosphonic Acids, Phosphinic Acids group was the largest at 56.0% 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 72.7% of pesticide active ingredient (mainly corn gluten meal) sold.

Looking at geographic distribution of agricultural product sales by outlet location related to major river drainage, sales in the Oldman River basin were highest overall at 20.5% of the total active ingredient sold, followed by sales within the Battle River basin at 19.1%, and the North Saskatchewan River basin at 17.6%.

Pesticide sales were also sorted by natural regions. The Parkland Natural Region constituted 44.1% of all pesticide active ingredient sales, mainly in the Central Parkland sub region. The Grassland Natural Region had 41.8% of provincial pesticide sales, mainly in the Dry Mixedgrass 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 sales report) were mapped along with reported sales. The South Saskatchewan region had 36% of total sales by active ingredient, with the North Saskatchewan region having just under 30% of sales.

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

Overall provincial estimated agricultural pesticide use intensity (based upon cultivated land acreage) was 1.37 kg ai/ha, relatively unchanged from the 1.33 kg ai/ha calculated for 2013, but 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.

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

List of Tables

List of Figures

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, 2008 and 2013), taking a more comprehensive look at pesticide sales in Alberta. Agricultural, domestic, commercial, livestock and structural sectors were surveyed (Byrtus 2000, 2007 and 2011, AENV 2015). 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 between 2003 and 2015 to inform policy decisions related to domestic pesticide regulatory actions.

For 2018, Alberta Environment and Parks undertook its sixth provincial scale review of pesticide sales; using the same data collection and reporting process as was implemented for previous surveys.

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 2018.

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 2019 requesting pesticide sales in Alberta for the calendar year 2018. Sales data was received throughout 2019 in various formats (hard copy and electronic). Records were received from approximately 85% 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 88,000 individual sales records.

Sales Data Limitations

Sector Representation

Products were classified into sectors based upon the type of vendor. However, 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 (commercial turf) were classified as sales to the Commercial/Industrial sector.

Treated Seed

Sales of fungicide and insecticide treated seed were newly requested in 2013, and were again specifically requested for 2018. Virtually all commercial agricultural retail vendors that supplied pesticide sales data also supplied treated seed sales. However, the sales distribution networks for treated seed are different than the chemical distribution networks, and some seed distributors may have been missed in the survey.

Vendor List

The vendors surveyed were based upon the list of vendors from Alberta Environment and Parks Environmental Management System, domestic product vendors previously 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 may not be 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 may not be 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 a combination of 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 2018 was sold in 2018. Also, some products were shipped through regional distribution systems, and some of that information was not accessed during the 2018 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 wholesale 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 2018. 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, natural region and Land Use Framework region. Secondary databases included Basin (which cross-referenced drainage basin and river basins), and Natural Region.

2.4 Data Processing

The databases and spreadsheets were imported into Microsoft Access® (2016) 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 (and other microbial products) are reported here as active ingredient instead of formulated product. The *Bacillus* values for 1998 included in Appendix 2 have been converted from kg of product to kg of active ingredient.

Although there were slightly over 88,000 individual sales records included in 2018, 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 over 144,000 individual records, active ingredient specific, which was 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 Canadian *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 2018 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 2018 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 2017 national pesticide sales report (PMRA 2019), 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 2017 report. As a result, Alberta sales data from 2018 was compared to 2018 data for Quebec and 2017 sales data nationally in order to give a perspective on the different pesticide uses. 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 Forestry publication “Crop Protection 2018” (AAF 2018).

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, 2013 and 2018.

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 Forestry (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 a natural region ID, which was then linked to the respective natural region and subregion in the Natural Region database. The detailed maps used to determine municipality location in relation to natural regions were from 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 based on 2016 agricultural census data collected by Statistics Canada.

3.0 RESULTS

In 2018, a total of 16 744 639 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 82.2% (Table 1). Sales of this group of products have leveled out after several years of increases.

Table 1. Pesticide Sales by Type of Use

Type of Use	2018 kg ai	2018 %	2013 kg ai	2013 %	2008 kg ai	2008 (%)
Herbicides, PGR's	13 759 642	82.2	13 200 340	86.7	10 257 303	82.2
Insecticides, Acaracides, Repellents	319 087	1.9	200 572	1.3	236 169	1.9
Fungicides	963 399	5.8	807 883	5.3	388 560	3.1
Vertebrate Repellents and Control Products	13 065	0.1	11 334	0.07	12 458	0.1
Adjuvants and Surfactants	1 684 881	10.1	1 010 265	6.6	1 580 104	12.7
Other	4 564	0.03	678	0.004	1 501	0.01
Total	**16 744 639**	**100**	**15 231 072**	**100**	**12 476 096**	**100**

Fungicides made up a small but growing proportion of sales (5.8%), while insecticides increased slightly from 2013 to 1.9% of sales. More insecticides associated with treated seed were reported in 2018 compared to 2013.

Vertebrate control products and repellents made up a very small percentage of pesticide sales, at 0.1%. As in 2013, this was dominated (70%) by a newer domestic class product used for mouse control (cellulose from powdered corn cobs).

Adjuvants and surfactants made up the second largest group, in terms of percentage of sales (10.1%). These compounds are used to enhance the effectiveness of herbicides on targeted weed(s).

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 2019) to enable provincial and national comparisons of sales data (Table 16).

The chemical group with the largest proportion of sales was the Phosphonic Acids, Phosphinic Acids group at 56 % (less than 2013, but comparable to 53.2% in 2008), followed by the Phenoxy Acids at 10.2%. The next group was the Fatty Acids & Surfactants at 7.0%. The remaining chemical groups were all under 3%, and 40 of the 53 chemical groups were under 1% of total sales.

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

Chemical Grouping	2018 kg ai	2018 %	2013 kg ai	2013 %
Phosphonic Acids, Phosphinic Acids	9 397 901	56.1	9 424 536.7	61.9
Phenoxy Acids	1 699 479	10.2	1 639 505.7	10.8
Fatty Acids & Surfactants	1 177 517	7.0	741 830.4	4.9
Triazoles	459 077	2.7	414 769.8	2.7
Benzonitriles	456 748	2.7	381 607.4	2.5
Hydrocarbons	398 003	2.4	218 049.6	1.4
Halogenated Organic Acids	382 751	2.3	256 044.6	1.7
Others	301 146	1.8	356 703.9	2.3

Acylureas	287 226	1.7	189 398.9	1.2
Carbamates	250 054	1.5	379 681.2	2.5
Ammoniums, Quaternary	230 894	1.4	68 066.1	0.4
Dinitrobenzenes	226 967	1.4	113 793.5	0.7
Azoles, Oxazoles, Thiazoles	195 019	1.2	122 374.8	0.8
Oils, Mineral and Vegetable	156 018	0.9	11 839.8	0.1
Anilides, Anilines	155 310	0.9	80 816.9	0.5
Cyclohexanedione oximes	151 966	0.9	95 701.1	0.6
Methoxyacrylates	144 335	0.9	100 570.3	0.7
Guanidines	133 323	0.8	99 906.6	0.7
Aryloxyphenoxyl Acids	80 175	0.5	95 469.8	0.6
Biscarbamates	70 343	0.4	36 060.7	0.2
Inorganics, Other	62 111	0.3	47 336.9	0.3
Benzoic Acid & Derivatives	57 695	0.3	55 629.0	0.4
Sulfonylureas	47 518	0.3	40 314.2	0.3
Imidazolinones	39 831	0.2	45 553.6	0.3
Triazines, Tetrazines	34 999	0.2	10 956.2	0.1
Benzamides	34 625	0.2	6 959.8	0.05
Amides	28 229	0.2	7 713.3	0.1
Dithiophosphates	20 622	0.1	24 009.4	0.2
Thiophosphates	13 404	0.08	37 513.1	0.2
Morpholines & Oxathiines	11 671	0.07	19 122.4	0.1
Pyrethroids, Pyrethrins	10 284	0.06	10 031.9	0.1
Urea Derivatives	8 685	0.05	27 134.3	0.2
Organic Acids	5 282	0.03	5 734.9	0.04
Pyridines	4 759	0.03	2 263.1	0.01
Organochlorines	3 577	0.02	450.3	0
Microbials	3 253	0.02	2 488.4	0.02
Alcohols	1 468	0.009	56 198.2	0.4
Phosphates	943	0.006	787.2	0.01
Diazines	814	0.005	691.0	0.0
Phthalic Acids	227	0.001	458.1	0.0
Inorganic Zincs	216	0.001	146.1	0.0
Nitrobenzenes	94	0.001	2655.5	0.02

Phosphoramidothioates	51	0.0	83.0	0.0
Pheremones	13	0.0	2.8	0.0
Aldehydes	7	0.0	48.9	0.0
Organometallics	5	0.0	12.0	0.0
Chromenones	3	0.0	13.2	0.0
Indanediones	2	0.0	2.1	0.0
Total	**16 744 639**	**100**	**15 231 071.5**	**100**

3.3 Sector of Use

Pesticide sales broken down by sector of use are listed in Table 3. Agricultural use dominates pesticide sales in Alberta at 95.8%. The Domestic and Commercial/Industrial Sectors each had 2% of sales. The Livestock sector made up less than 0.1% of all sales. The sectoral breakdowns were comparable the 2013 results, with a slight decrease 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	2018 kg ai	2018 %	2013 kg ai	2013 %	2008 kg ai	2008 %
Agriculture	16 048 654	95.8	14 515 028	95.3	11 985 048	96.1
Commercial /Industrial	359 678	2.1	299 775	2.0	388 537	3.1
Domestic	335 267	2.0	414 718	2.7	89 534	0.7
Livestock	1039	0.01	1 551	0.0	12 977	0.1
Grand Total	**16 744 639**	**100**	**15 231 072**	**100**	**12 476 096**	**100**

3.3.1 Agricultural Sector

Herbicides made up the majority of pesticide sales in the agricultural sector, with 82.4% of all sales. Adjuvants were the next highest category, at over 10% of pesticide sales. Fungicide sales was the next category at 5.8%, while insecticides represented 1.5% of agricultural pesticide sales in Alberta. These values were comparable to 2013 sales figures.

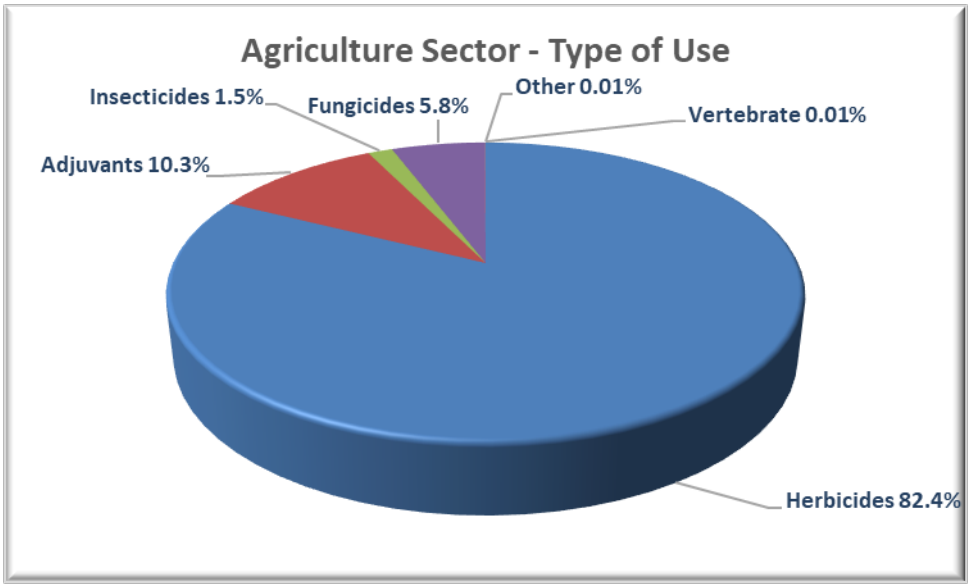

Figure 1. Agriculture Sector – Type of Use

The top 15 active ingredients sold in the agricultural market in Alberta in 2018 are listed in Table 4, with comparisons to the agricultural sales of those active ingredients in 2013, 2008, and 2003. Very little change in sales was observed for glyphosate, after increasing significantly over previous sales surveys. Bentazon, diquat and ethalfluralin increased significantly over 2013 sales.

No insecticides were in the top 15 of agricultural pesticide sales.

Table 4. Top 15 Agricultural Active Ingredients Sold in 2018. 2013, 2008, and 2003

Active Ingredient	Usage	2018 Sales (kg ai)	2013 Sales (kg ai)	2008 Sales (kg ai)	2003 Sales (kg ai)	% Change (2013 to 2018)
Glyphosate	Herbicide	8 289 611	8 667 958.8	6 125 309.7	3 333 994.5	-4.4
Glufosinate	Herbicide	950 679	694 347.4	394 652.8	106 689.6	+36.9

Active Ingredient	Usage	2018 Sales (kg ai)	2013 Sales (kg ai)	2008 Sales (kg ai)	2003 Sales (kg ai)	% Change (2013 to 2018)
MCPA	Herbicide	925 350	920 011.3	1 028 115.8	1 096 848.9	+0.5
Surfactant Blend	Adjuvant	754 758	299 027.9	401 107.1	437 400.5	+138.2
2,4-D	Herbicide	641 052	565 725.7	840 464.6	685 294.5	+13.3
Petroleum Hydrocarbon Blend	Adjuvant	397 956	215 138.9	656 588.2	559 728.7	+85.0
Bromoxynil	Herbicide	367 728	315 620.6	330 177.1	354 906.6	+16.5
Bentazon	Herbicide	264 765	117 357.2	20 481.0	21 986.9	+125.6
Fluroxypyr	Herbicide	261 166	156 865.7	71 814.1	43 166.7	+66.5%
Triallate	Herbicide	222 547	367 416.9	101 072.2	197 221.4	- 48.9
Diquat	Herbicide	173 706	61 204.4	34 893.9	25 524.4	+183.8
Ethalfluralin	Herbicide	171 059	87 128.4	82 873.7	168 135.0	+96.3%
Polyoxyalkylated alkyl phosphate ester	Adjuvant	140 892	97 257.9	55 943.9	13 727.8	+44.9
Paraffin Base Petroleum Oil	Adjuvant	139 836	62 188.2	22 939.3	27 958.4	+124.9%
Prothioconazole	Fungicide	133 418	81 609.0	26 517.0	0.0	+63.5

The chemical group breakdown was conducted on the agricultural pesticide sales (Table 5).

The Phosphonic/Phosphinic Acids group dominated the Alberta agricultural sales at over 58%, a slight decrease in percentage but virtually unchanged in volume since 2013. The Phenoxy Acids group increased slightly in overall and proportional sales in 2018, but still accounted for almost 10% of sales. The surfactants (Fatty Acids and Surfactants) increased in sales from 2013. The Triazoles had increased between 2013 and 2018 in overall sales but percentage sales were identical. The Carbamates had tripled in sales between 2008 and 2013, but dropped by over 127,000 kg in 2018. The Hydrocarbons increased in 2018 (over 180,000 kg ai), after 2013 sales dropped to a third of the 2008 sales. The Oils category increased significantly in 2018 with new products (methylated soybean oil) and increased sales of existing products (mineral oils) being used in the agricultural market.

Table 5. Summary of Agricultural Pesticide Sales by Chemical Group

	2018		2013	
Chemical Group	Kg ai	%	Kg ai	%
Phosphonic Acids, Phosphinic Acids	9 316 961	58.1	9 365 183.8	64.5
Phenoxy Acids	1 585 580	9.9	1 518 462.3	10.5
Fatty Acids & Surfactants	1 144 770	7.1	718 811.3	5.0
Triazoles	455 808	2.8	412 181.6	2.8
Benzonitriles	430 388	2.7	364 772.3	2.5
Hydrocarbons	397 956	2.5	215 138.9	1.5
Halogenated Organic Acids	367 875	2.3	233 932.9	1.6
Acylureas	282 662	1.8	181 360.4	1.2
Carbamates	248 701	1.5	376 115.1	2.6
Ammoniums, Quaternary	230 188	1.4	67 320.5	0.5
Dinitrobenzenes	226 666	1.4	113 788.7	0.8
Azoles, Oxazoles, Thiazoles	193 051	1.2	121 846.5	0.8
Anilides, Anilines	154 580	1.0	80 357.1	0.6
Cyclohexanedione oximes	151 966	1.0	95 701.1	0.7
Methoxyacrylates	143 802	0.9	100 153.9	0.7
Guanidines	133 110	0.8	99 752.1	0.7
Oils, Mineral & Vegetable	130 782	0.9	4.7	0
Aryloxyphenoxyl Acids	80 174	0.5	95 467.8	0.7
Biscarbamates	68 892	0.4	35 719.8	0.2
Benzoic Acid & Derivatives	48 714	0.3	39 556.3	0.3
Sulfonylureas	45 807	0.3	39 261.8	0.3
Imidazolinones	37 348	0.2	40 469.8	0.3
Triazines, Tetrazines	33 525	0.2	9 026.2	0.06
Amides	27 953	0.2	7 571.7	0.05
Benzamides	24 772	0.2	983.9	0.007
Inorganics, Other	22 632	0.1	27 472.8	0.1
Dithiophosphates	15 481	0.1	19 393.6	0.1
Thiophosphates	13 379	0.08	37 430.3	0.3
Morpholines & Oxathiines	11 671	0.07	19 119.5	0.1
Pyrethroids, Pyrethrins	7 048	0.04	8 268.1	0.06
Urea Derivatives	5 667	0.04	4 995.4	0.03
Pyridines	4 619	0.03	2 209.8	0.02
Microbials	2 058	0.014	903.0	0.006
Alcohols	1 224	0.008	55 385.8	0.4
Others	1 189	0.007	2 085.2	0.01
Diazines	793	0.005	680.9	0.005
Phosphates	670	0.005	568.3	0.004
Organic Acids	87	0.001	458.0	0.003
Nitrobenzenes	85	0.001	2 655.5	0.02

	2018		2013	
Chemical Group	Kg ai	%	Kg ai	%
Phosphoramidothioates	15	0	27.0	0
Phthalic Acids	3	0	109.2	0.001
Chromenones	2	0	0.6	0
Indanediones	0.3	0	0.2	0
Total	**16 048 654**	**100**	**14 515 027.8**	**100**

3.3.2 Domestic Sector

In the domestic sector (Figure 2), herbicides again dominated at just over 80% of sales, slightly down from 88% in 2013, while insecticide sales increased slightly to 14.4% from 9% in 2013, mainly as a result of more DEET and paradichlorobenzene sales. Herbicide sales are dominated by corn gluten meal, a weed germination inhibitor product, which is being used by homeowners as a replacement for the historical chemical weed and feed herbicides. This product is 99-100% active ingredient, compared to the chemical weed and feed products that had only 1-2% active ingredient. Vertebrate product sales increased in 2018 as a result of another newer product with a high active ingredient guarantee (cellulose from powdered corn cobs).

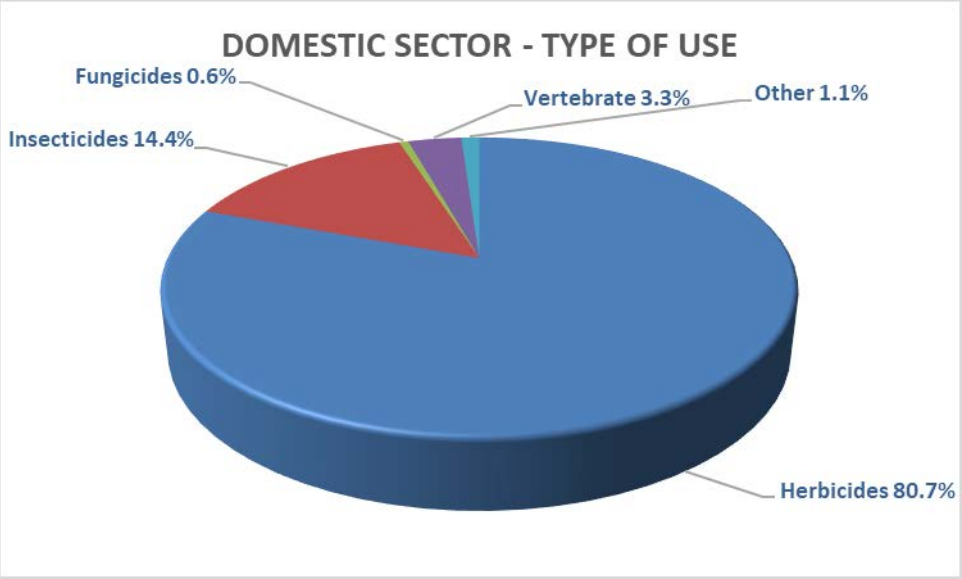

Figure 2. Domestic Sector – Type of Use

As with the agricultural products, the domestic product sales were also broken down by chemical group (Table 6). In the Domestic sector, the Others category dominated at 73% of total domestic pesticide sales, followed by Inorganics and Phosphonic/Phosphinic Acids and the Phenoxy Acids. These four groups combined made up over 90% of all domestic sales.

The Others group is dominated (99.7%) by the corn products (corn gluten meal, 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 sales substitutions for lawn herbicides is not possible.

Reclassification of the chemical grouping used for categorization to align better with the PMRA categories was done for 2018, and the products formerly in the Miscellaneous (Non-Classified) group are now in the Others group.

Table 6. Summary of Domestic Pesticide Sales by Chemical Group – 2018 and 2013

Chemical Group	2018 kg ai	%	2013 kg ai	%
Others	243 717	72.7	343 905.8	82.9
Inorganics, Other	34 333	10.2	18 088.0	4.6
Phenoxy Acids	12 917	3.9	11 684.0	2.8
Phosphonic Acids, Phosphinic Acids	12 713	3.8	12 917.0	3.1
Benzamides	9 820	2.9	5 711.9	1.4
Dithiophosphates	4 779	1.4	3 080.8	0.7
Organochlorines	3 577	1.1	122.3	0.03
Oils, Mineral and Vegetable	2 989	0.9	2 899.9	0.7
Fatty Acids & Surfactants	2 436	0.7	2 213.8	0.5
Organic Acids	1 995	0.6	5 081.5	1.2
Pyrethroids, Pyrethrins	1 648	0.5	906.2	0.2
Triazines, Tetrazines	737	0.2	0.0	0
Carbamates	694	0.2	2 745.2	0.7
Benzoic Acid & Derivatives	649	0.2	628.7	0.2
Urea Derivatives	609	0.2	0.0	0
Ammoniums, Quaternary	559	0.2	0.0	0
Phosphates	263	0.08	189.0	0.05
Azoles, Oxazoles, Thiazoles	231	0.07	0.02	0
Inorganic Zincs	216	0.06	146.1	0.04
Phthalic Acids	182	0.05	286.9	0.07

Chemical Group	2018 kg ai	%	2013 kg ai	%
Biscarbamates	50	0.01	90.0	0.02
Alcohols	49	0.01	39.5	0.01
Hydrocarbons	47	0.01	2 903.0	0.7
Microbials	35	0.01	13.7	0.0
Pheromones	7	0.002	0.0	0
Aldehydes	6	0.002	48.9	0.01
Amides	5	0.001	1.6	0
Chromenones	1	0	12.4	0
Pyridines	0.9	0	0	0
Indanediones	0.5	0	0.2	0
Dinitrobenzenes	0.4	0	0.0	0
Guanidines	0.3	0	0.0	0
Acylureas	0.02	0	0.0	0
Phenols	0.0	0	1.3	0
Thiophosphates	0.0	0	0.1	0
Diazines	0.0	0	0.1	0
Total	**335 273**	**100**	**414 717.9**	**100**

The top domestic active ingredients sold in 2018 are listed in Table 7. Corn gluten meal was not sold in Alberta in 2008, but jumped to over 330 000 kg in 2013, dropping off to 233 369 kg of active ingredient in 2018. Silicon dioxide (salt water fossils, or diatomaceous earth) sales continued to increase in 2018, after doubling in sales from 2008, as products containing this active ingredient continue 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. New active ingredients that have come onto the market since 2008 include cellulose from powdered corn cob, which is used as a mouse control product, chelated iron and sulfur used for vertebrate control. The top selling active ingredient in 2008 was 2, 4-D, but sales dropped extensively in 2013, with a slight rise by 2018. Paradichlorobenzene (used in moth balls) sales increased extensively in 2018, but the reason for the increase is unknown at this time.

Table 7. Top 15 Domestic Active Ingredients Sold in 2018, 2013, 2008 and 2003

Domestic active ingredient	2018 kg ai	2013 kg ai	2008 kg ai	2003 kg ai
Corn Gluten Meal	233 369	330 967.4	0.0	0.0
Silicon dioxide salt water fossils	18 938	14 035.8	6 666.6	7 509.2
Glyphosate	12 712	12 768.3	11 167.6	10 448.5
DEET	9 820	5 711.9	1 201.7	3 413.3
Cellulose from powdered corn cob	9 134	9 596.9	0.0	0.0
2,4-D	9 086	7 989.9	25 107.2	14 392.5
Ferrous sulfate	6 695	180.2	7 846.5	1 593.4
Malathion	4 779	3 080.0	3 116.7	1 667.8
Paradichlorobenzene	3 577	122.3	508.5	13.9
Mecoprop-P	3 831	3 694.2	12 087.0	6 273.8
Mineral Oil (Insecticidal)	2 905	2 884.2	1 701.4	838.9
Silicon dioxide fresh water fossils	2 462	280.0	29.0	0.0
Acetic Acid	1 927	4 984.2	1 815.5	1 130.5
Iron FeHDTA	1 296	1 327.6	0.0	0.0
Potassium Salts of Fatty Acids	1 142	759.0	687.3	0.0

3.3.3 Commercial/Industrial Sector

In the Commercial/Industrial Sector, herbicides again dominated at almost 72% of pesticide sales (Figure 3). Insecticides made up over 8%. Fungicide sales were proportionately slightly higher in this sector at almost 11%, 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.

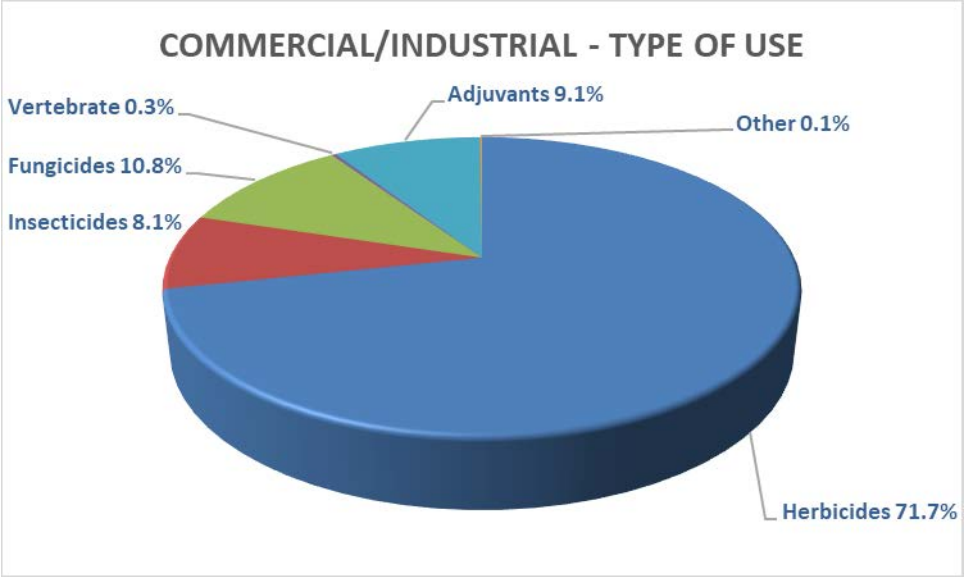

Figure 3. Commercial/Industrial Sector – Type of Use

Table 8. Top 15 Commercial/Industrial Active Ingredients Sold in 2018, 2013, 2008 and 2003

Commercial/Industrial Active Ingredient	2018 kg ai	2013 kg ai	2008 kg ai	2003 kg ai
2,4-D	69 835	67 455.4	107 510.5	63 670.6
Glyphosate	68 073	46 176.9	99 021.2	75 379.1
Acrolein	54 102	10 367.9	9 051.0	16 981.4
Chlorothalonil	26 220	16 756.4	3 605.0	4 363.5
Mineral Oil (Insecticide)	22 166	8 935.2	2 196.3	1 394.8
Mecoprop-P/Mecoprop	16 987	7 996.0	19 933.7	12 288.0
Paraffin Base Mineral Oil	15 789	0.0	0.0	0.0
Triclopyr	12 619	32 690.4	23 932.8	29 625.6
Surfactant Blend	8 216	1886.4	533.8	835.2
Aminopyralid	6 831	9 086.5	3 539.6	0.0
Dicamba	6 058	15 443.9	15 931.9	12 344.2
Octadec-9-enoic acid	5 426	18 097.2	0.0	0.0
Picloram	5 388	10 962.7	14 574.7	13 302.3
Iprodione	4 560	4 079.4	2 381.8	2 109.9
Imazapyr	2 483	5 083.8	3 739.2	1 675.8

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 47% 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 – 2018, 2013 and 2008

Chemical Group	2018 kg ai	%	2013 kg ai	%	2008 kg ai	%
Phenoxy Acids	100 982	28.1	109 359.4	36.5	154 836.4	39.9
Phosphonic Acids, Phosphinic Acids	68 227	19.0	46 435.9	15.5	99 098.0	25.5
Others	55 798	15.5	10 462.1	3.5	9 139.3	2.4
Fatty Acids & Surfactants	30 311	8.4	20 805.3	6.9	3 917.1	1.0
Benzonitriles	26 360	7.3	16 835.0	5.6	3 709.4	1.0
Oils, Mineral and Vegetable	22 247	6.2	8 935.2	3.0	2 196.3	0.6
Halogenated Organic Acids	14 875	4.1	22 111.7	7.4	19 088.3	4.9
Benzoic Acid & Derivatives	8 332	2.3	15 443.9	5.2	15 938.2	4.1
Inorganics, Other	5 146	1.4	776.0	0.2	1 172.4	0.3
Acylureas	4 564	1.3	8 038.6	2.7	4 022.2	1.0
Triazoles	3 269	0.9	2 588.2	0.9	4 646.5	1.2
Organic Acids	3 200	0.9	195.5	0.1	10 199.7	2.6
Imidazolinones	2 483	0.7	5 083.8	1.7	3 739.2	1.0
Urea Derivatives	2 409	0.7	22 138.9	7.4	31 716.9	8.2
Azoles, Oxazoles, Thiazoles	1 736	0.5	528.3	0.2	70.1	0.02
Sulfonylureas	1 711	0.5	1 052.4	0.4	258.3	0.1
Biscarbamates	1 401	0.4	250.8	0.1	2 679.0	0.7
Pyrethroids, Pyrethrins	1 161	0.3	561.1	0.2	456.2	0.1
Microbials	1 160	0.3	1 571.7	0.5	292.5	0.1
Triazines, Tetrazines	737	0.2	1 930.0	0.6	2.7	0.0
Anilides, Anilines	730	0.2	459.8	0.2	47.5	0.01
Carbamates	642	0.2	472.0	0.2	1 399.8	0.4
Methoxyacrylates	533	0.1	416.5	0.1	289.0	0.1
Dithiophosphates	362	0.1	1 126.9	0.4	421.9	0.1
Dinitrobenzenes	300	0.1	4.8	0.0	0.00004	0.0
Amides	271	0.1	140.0	0.05	148.4	0.04
Guanidines	202	0.1	154.5	0.1	79.3	0.02
Ammoniums, Quaternary	142	0.04	665.6	0.2	258.7	0.1
Pyridines	128	0.04	43.5	0.01	44.3	0.01
Alcohols	103	0.03	662.7	0.2	1 690.2	0.4

Chemical Group	2018 kg ai	%	2013 kg ai	%	2008 kg ai	%
Phosphoramidothioates	36	0.01	56.0	0.02	210.5	0.1
Benzamides	33	0.01	264.1	0.1	94.9	0.02
Phthalic Acids	26	0.01	53.5	0.02	72.0	0.02
Diazines	21	0.01	10.0	0.0	350.6	0.1
Thiophosphates	10	0.0	80.1	0.03	195.4	0.1
Phosphates	10	0.0	29.0	0.01	155.1	0.04
Nitrobenzenes	9	0.0			7 550.4	1.9
Organometallics	5	0.0	12.0	0.0	8.6	0.0
Pheremones	2	0.0	1.8	0.0	176.5	0.05
Indanediones	2	0.0	1.7	0.0	22.1	0.01
Aryloxyphenoxyl Acids	1	0.0	2.0	0.0		
Aldehydes	0.9	0.0			456.0	0.1
Chromenones	0.7	0.0	0.2	0.0	0.5	0.0
Hydrocarbons			7.7	0.0		
Organochlorines			4.0	0.0	63.5	0.02
Morpholines & Oxathiines			2.9	0.0	1 086.1	0.3
Organohalogens					6 106.3	1.6
Dithiocarbamates					392.0	0.1
Chlorotriazines					33.8	0.01
Inorganic Zincs					2.7	0.0
Oximes-Carbamates					2.4	0.0
Total	**359 678**	**100**	**299 775.2**	**100.0**	**388 537.0**	**100.0**

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 piperonyl butoxide (42.6% - synergist used with pyrethrins), permethrin (26% - insecticide), cyfluthrin (9.1% - insecticide) and butoxypolypropylene glycol (8.9% - repellent).

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 Oldman River basin had the highest proportion of agricultural pesticide sales, at over 20%, followed by the Battle River, the North Saskatchewan River, the Red Deer River and the Peace River basins. The increase in sales for the Oldman River and the decrease in sales for the South Saskatchewan River are related to a chain of vendors in southern Alberta that provided sales records for the chain instead of by outlet. These records were assigned to the Oldman River basin, although some of the vendor outlets are in the South Saskatchewan River basin.

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

	2018		2013		2008	
River Basin	**kg ai**	**(%)**	**kg ai**	**(%)**	**kg ai**	**(%)**
Oldman River	2 949 073	20.5	2 041 522.1	14.1	2 068 309.6	19.9
Battle River	2 752 161	19.1	2 301 057.1	15.9	1 544 739.9	14.8
North Saskatchewan River	2 536 864	17.6	2 409 680.1	16.6	1 393 229.6	13.4
Red Deer River	1 818 339	12.6	2 208 033.3	15.2	1 770 580.7	17.0
Peace River	1 672 915	11.6	1 760 903.0	12.1	1 202 936.2	11.6
Bow River	878 593	6.1	809 930.9	5.6	825 266.5	7.9
South Saskatchewan River	801 132	5.6	1 556 633.7	10.7	872 798.3	8.4
Athabasca River	488 250	3.4	547 991.3	3.8	360 375.6	3.5
Sounding Creek	333 543	2.3	288 739.2	2.0	213 163.7	2.0
Milk River	76 855	0.5	76 182.7	0.5	79 640.0	0.8
Beaver River	75 478	0.5	98 346.7	0.7	77 237.5	0.7
Non-specific basin	13 220	0.1	416 007.7	2.9	1 368.5	0.0
Total	**14 396 423**	**100**	**14 515 027.8**	**100**	**10 409 646.5**	**100**

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 Athabasca and Red Deer River basins. The South Saskatchewan basin sales dropped in 2018, while the remaining basins were relatively unchanged. The increase for all basins between 2008

and 2013 is related to the corn gluten product sales that came onto the market for lawn weed control.

Table 11. Total Domestic Pesticide Sales by River Basin

River Basin	2018 kg ai	2013 kg ai	2008 kg ai
North Saskatchewan	93 435	139 659.6	26 095.2
Bow River	85 221	124 567.4	20 276.6
Athabasca River	28 178	26 889.0	4 015.1
Red Deer River	26 069	30 942.9	7 208.1
Oldman River	21 028	16 619.6	5 106.9
Peace River	18 020	18 998.1	3 532.3
Battle River	12 824	13 326.4	9 785.4
Beaver River	8 969	7 479.2	912.1
South Saskatchewan River	8 764	17 763.7	2 816.8
Milk River	737	3.2	42.5
Sounding Creek	250	157.3	88.8
Hay River	0	4.8	2.5
Non-specific basin	31 771	18 306.6	9 651.3
Total	**335 267**	**414 717.9**	**89 533.6**

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 almost 39% of provincial sales, was in the Central Parkland sub-region. The Dry Mixedgrass sub-region was next at 21.6 %, followed by the Dry Mixedwood sub-region at almost 13%, and the Mixedgrass sub-region at 9.6%. 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 Regions

Natural Region	Sub Region	2018 kg ai	2018%	2013 kg ai	2008 kg ai
Alberta (non-specific region)		**140 763**	**0.8**	**477 866.7**	**217 799.0**
Boreal	Central Mixedwood	43 759	0.3	44 419.6	21 549.7
	Dry Mixedwood	2 138 518	12.8	2 127 838.3	1 664 332.9
	Lower Boreal Highlands	0.0	0.0	3.6	2.4
	Northern Mixedwood	0.0	0.0	0.5	0
Boreal Total		**2 182 277**	**13.0**	**2 172 262.0**	**1 685 885.0**
Foothills	Lower Foothills	38 763	0.2	6 302.8	5 652.2
	Upper Foothills	356	0.0	2.0	15.0
Foothills Total		**39 030**	**0.2**	**6 304.8**	**5 667.1**
Grassland	Dry Mixedgrass	3 624 644	21.6	2 697 136.7	2 284 841.7
	Foothills Fescue	1 236 938	7.4	1 101 800.5	1 061 066.0
	Mixedgrass	1 612 100	9.6	1 958 689.5	2 128 080.6
	Northern Fescue	516 814	3.1	766 290.7	584 808.0
Grassland Total		**6 990 496**	**41.8**	**6 523 917.4**	**6 058 796.4**
Parkland	Central Parkland	6 514 003	38.9	5 222 417.7	3 986 293.9
	Foothills Parkland	8 183	0.05	14 854.9	8 898.9
	Peace River Parkland	862 803	5.2	805 637.9	510 644.9
Parkland Total		**7 384 989**	**44.1**	**6 042 910.5**	**4 505 837.6**
Rocky Mountain	Montane	**7 083**	**0.04**	**7 810.2**	**2 110.7**
Total		**16 744 639**	**100.0**	**15 231 071.5**	**12 476 095.8**

3.4.3 Total Pesticide Sales by Land Use Framework Region

The Government of Alberta initiated the Land Use Framework in 2006 to better manage public and private lands and natural resources to achieve Alberta's long term goals (Land Use Secretariat 2008). 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).

Because the South Saskatchewan region has three river basins, this led to this region having the largest volume of sales, at 36% of the provincial total, followed by the North Saskatchewan region at just under 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 Regions

Land Use Framework Region	2018 kg ai	%	2013 kg ai	%	2008 kg ai	%
Alberta	140 763	0.8	477 866.7	3.1	217 799.0	1.8
Lower Athabasca	68 774	0.4	88 468.9	0.6	70 997.7	0.6
Upper Athabasca	567 190	3.4	600 898.7	3.9	434 667.3	3.5
Lower Peace	458 537	2.7	487 720.6	3.2	355 240.3	2.9
Upper Peace	1 455 785	8.7	1 336 283.4	8.8	1 049 653.6	8.4
North Saskatchewan	4 881 587	29.2	4 659 034.4	30.6	3 139 318.3	25.2
Red Deer	3 142 878	18.8	2 381 723.6	15.6	2 136 500.6	17.1
South Saskatchewan	6 029 124	36.0	5 199 075.2	34.1	5 071 919.0	40.6
Total	**16 744 639**	**100**	**15 231 071.5**	**100**	**12 476 095.8**	**100**

3.4.4 Pesticide Sales by Municipality

Total Pesticide Sales

Total sales (all sectors and all products) for all of the municipalities in Alberta are summarized in Table 14. 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 Taber, Vermilion River, Ponoka, Wheatland, Flagstaff and Forty Mile having the highest sales. Taber sales were affected by a regional agricultural input

vendor with multiple outlets in southeastern Alberta, but their sales were not broken down by outlet, and were attributed to the Taber area for reporting purposes.

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 14. Total Pesticide Sales by Municipality (2018)

Municipality	kg ai	Municipality	kg ai	Municipality	kg ai
Taber	2 124 329	Fairview	228 212	City of Edmonton	59 351
Vermilion River	834 727	Mountain View	228 181	Clear Hills	57 545
Ponoka	828 302	Paintearth	223 213	Bonnyville	56 958
Wheatland	699 570	Special Area 3	219 793	Starland	56 299
Flagstaff	596 938	Wainwright	208 226	Pincher Creek	38 250
Forty Mile	586 544	Barrhead	193 007	Saddle Hills	36 402
Camrose	458 273	Westlock	192 682	Thorhild	33 882
Grande Prairie	455 072	Lacombe	188 068	Peace	29 934
Vulcan	437 335	Beaver	178 443	Yellowhead	23 705
Red Deer	432 869	Strathcona	168 612	Brazeau	18 274
Lethbridge	432 656	Cardston	167 133	Clearwater	13 256
Minburn	397 904	Smoky Lake	155 083	Lac Ste. Anne	10 571
Provost	385 920	Special Area 2	143 313	Birch Hills	9 995
Cypress	366 702	Alberta	140 763	Wood Buffalo	9 539
Kneehill	366 159	Willow Creek	140 339	Woodlands	7 298
Spirit River	335 478	Drumheller	138 994	Greenview	6 406
Sturgeon	298 603	Foothills	124 465	Bighorn	2 688
Smoky River	296 740	Wetaskiwin	124 319	Lac La Biche	2 278
Warner	293 731	City of Calgary	116 142	Ranchland	1 752
Leduc	267 941	Mackenzie	107 170	Lesser Slave River	1 262
Rocky View	252 260	Two Hills	105 345	Banff Nat. Park	520
Northern Sunrise	249 353	Northern Lights	101 822	Opportunity	192

Municipality	kg ai	Municipality	kg ai	Municipality	kg ai
Lamont	248 097	Parkland	92 533	Jasper Nat. Park	101
Newell	244 709	Special Area 4	80 247	Elk Island Nat. Park	50
Stettler	237 441	Athabasca	74 525		
St. Paul	235 808	Big Lakes	64 038		
				Total	**16 744 639**

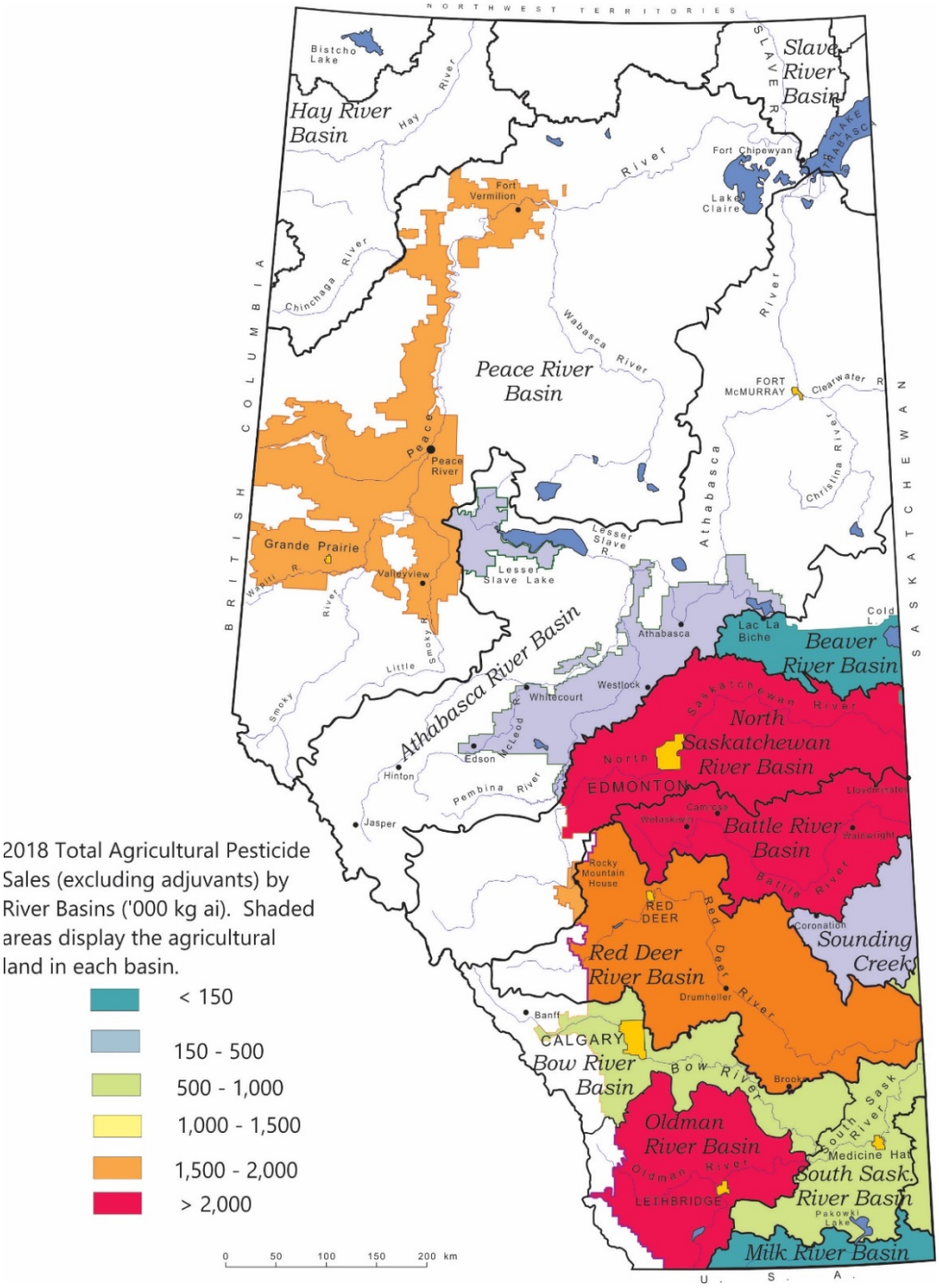

Figure 4. Total Agricultural Pesticide Sales (excluding adjuvants) by River Basin (‘000 kg ai)

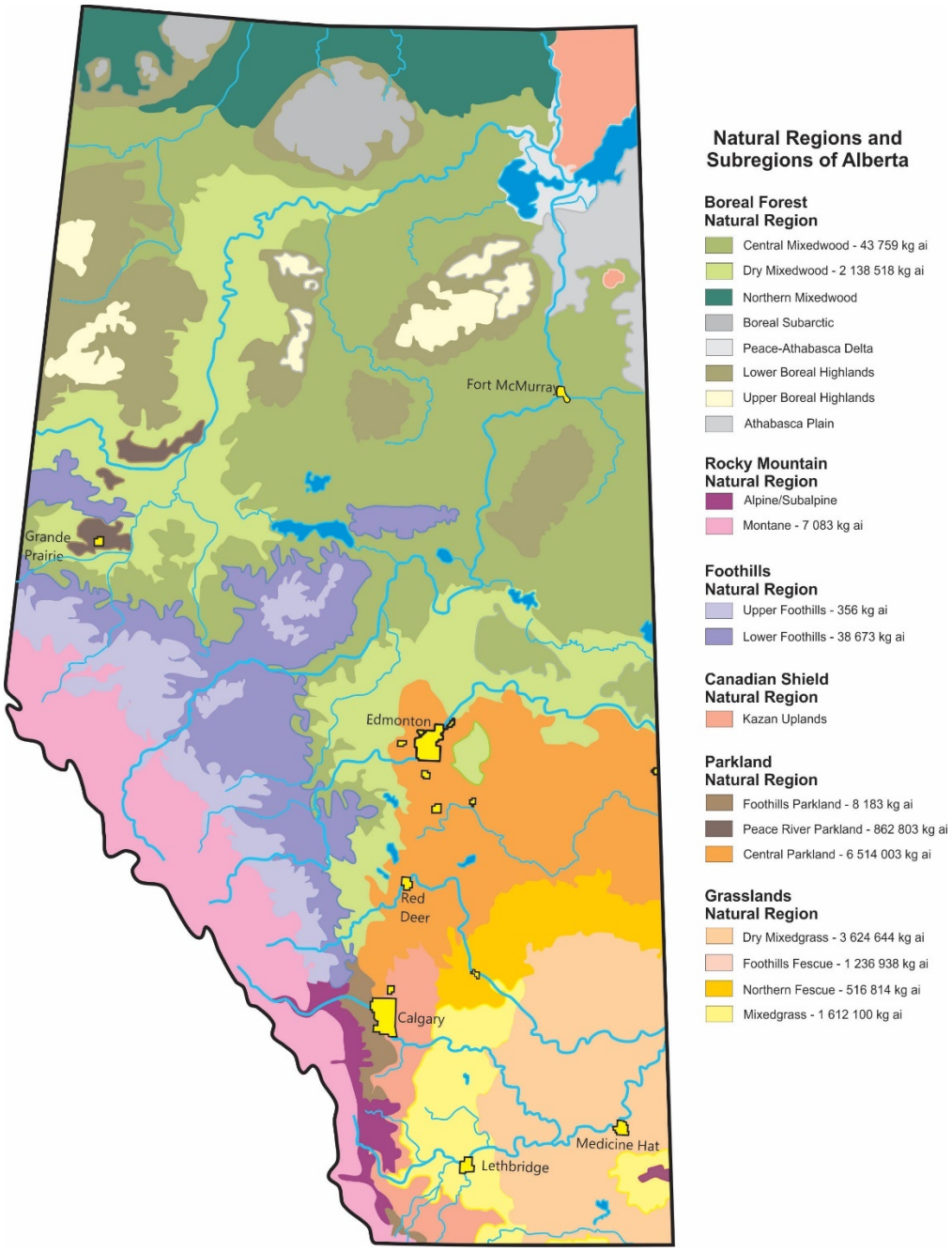

Figure 5. Total Pesticide Sales by Natural Regions and Subregions (kg ai) - 2018

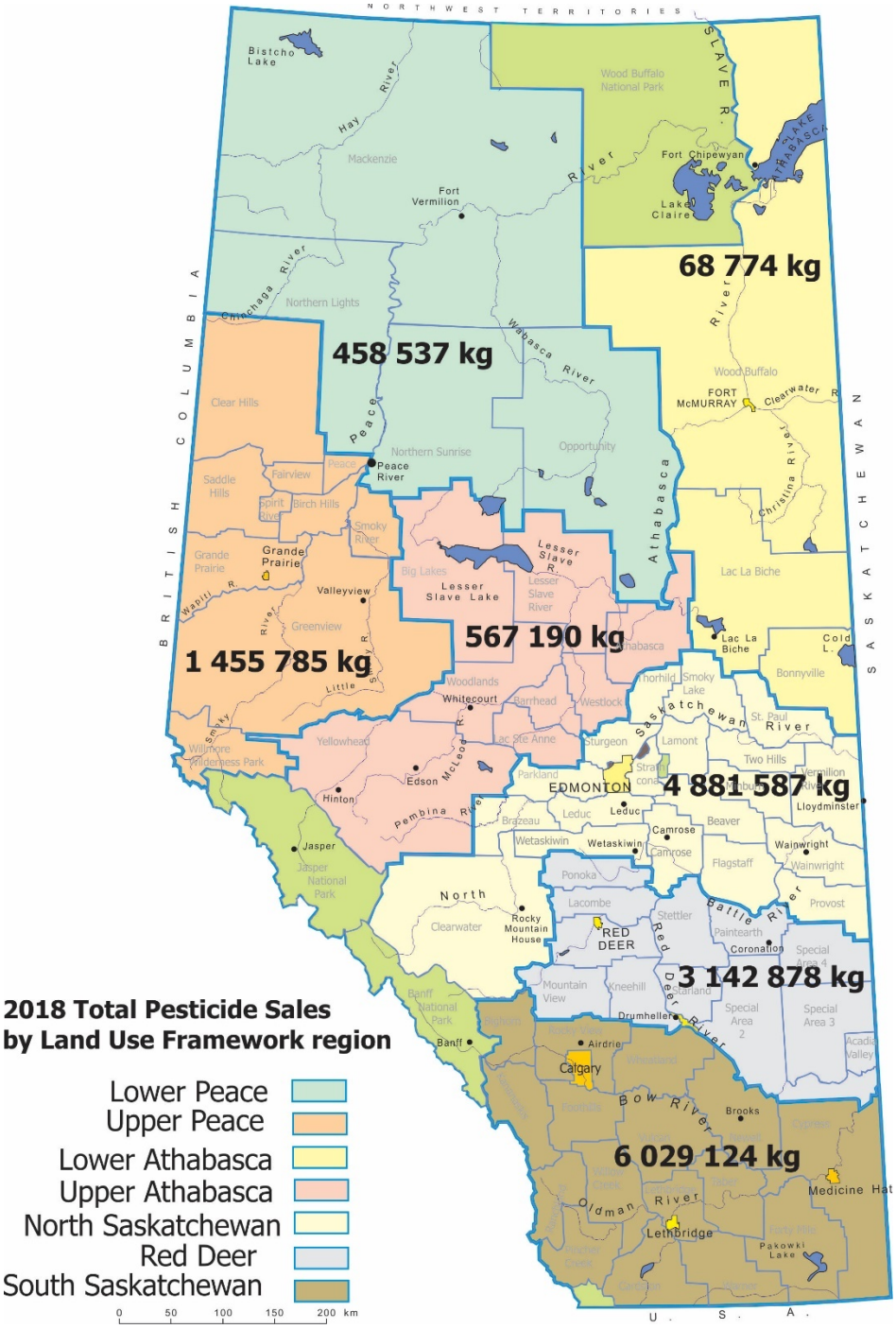

Figure 6. Total Pesticide Sales by Land Use Framework Region (kg ai) - 2018

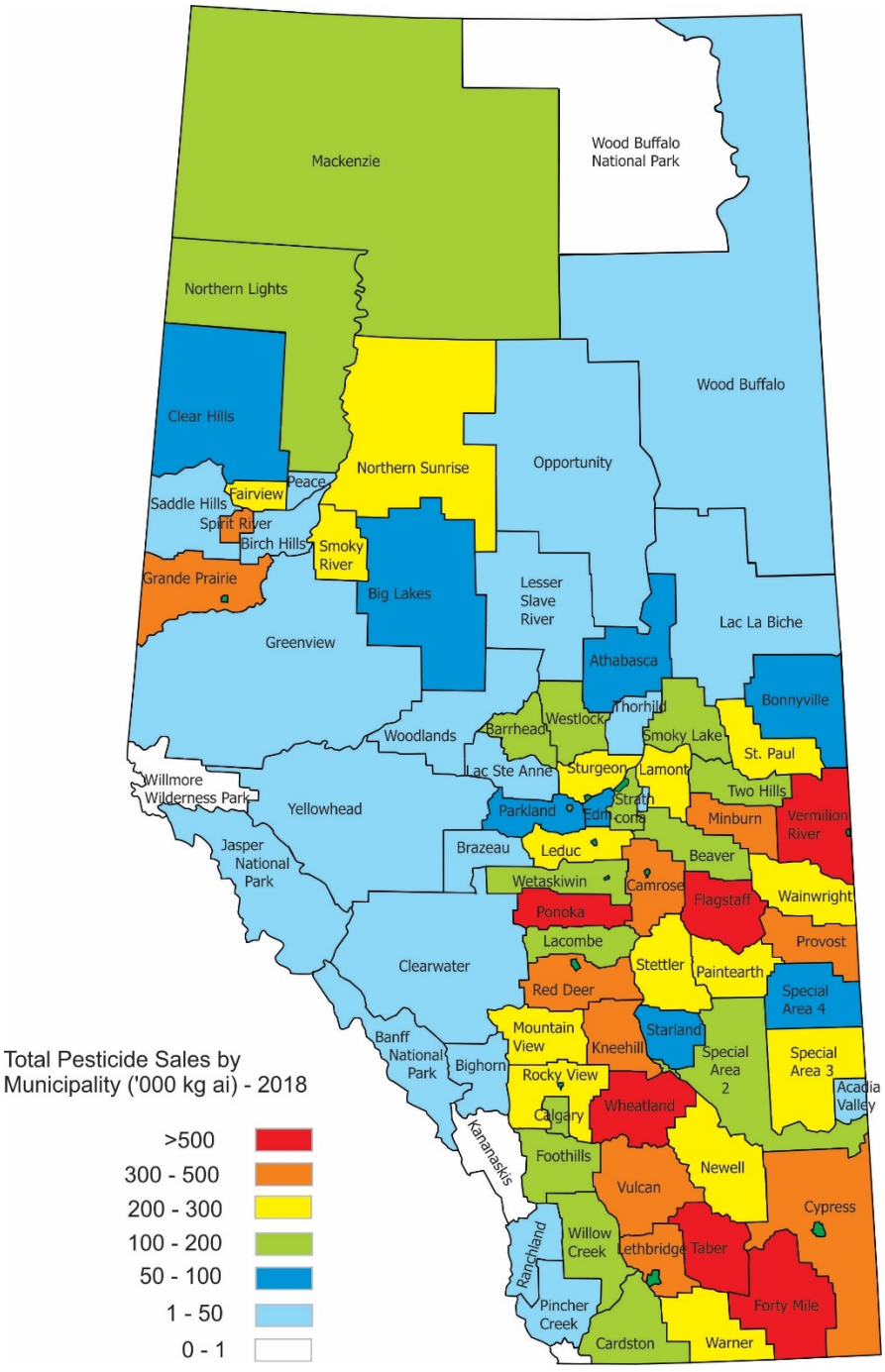

Figure 7. Total Pesticide Sales by Municipality (‘000 kg ai) - 2018

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 agricultural 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, 2013 and 2018 surveys include agricultural sales data from the line companies and independent dealers.

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, AAF 2018) (Table 15). 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 15. Agricultural pesticide use comparison 1988-2018 (excluding adjuvants)

	1988*	1993*	1998	2003	2008	2013	2018
Ag Pesticide Sales (kg ai)	6 956 950	7 491 440	7 588 662	7 561 854	10 409 647	13 525 692	14 396 423
Cropland area (ha)(census survey year in brackets)	9 162 850	9 292 374	9 546 886	9 728 527	10 222 234	10 164 322	10 470 082
	(1986)	(1991)	(1996)	(2001)	(2006)	(2011)	(2016)
Pesticide use intensity (kg/ha)	0.76	0.81	0.79	0.78	1.02	1.33	1.37

*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. Use intensity increased only slightly by 2018, as glyphosate sales declined slightly, but other product sales rose (e.g., diquat).

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 the 2008 and 2013 sales reports. 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 the 2008 sales report, mainly as result of including 660,000 ha of chemfallow in the total. This trend was carried into 2013 reporting. The 2016 agricultural census did not distinguish between chemfallow or tillage summerfallow acreage, so the entire summerfallow acreage was included in the 2018 total acreage.

More detailed breakdown of pesticide sales by municipality (Figure 7) 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 annual pesticide sales reporting, based on sales reported by registrants. 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 and active ingredient reporting grouped by range of sales totals. The chemical group sales reporting is included in Table 16, with the comparable Alberta and Quebec sales. At the time of preparation of the 2018 Alberta sales report, the 2018 Quebec sales report was available, but the national sales report was only available for the 2017 reporting season (PMRA, 2019).

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 16%, 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 13% 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.

One interesting anomaly is the halogenated organic acid values, where Alberta's reported sales in 2018 of 382 751 kg ai was considerably larger than the national reported total for 2017 (85 377 kg ai). The products in this category are widely used across western Canada in crop production (fluroxypyr, clopyralid, etc,), so this distinction can only be attributed to classification differences between the reporting agencies.

Table 16. Alberta (2018), Quebec (2018) and Canada (2017) Pesticide Sales by Chemical Group

Chemical Group	2018 Alberta kg ai	%	2018 Quebec kg ai	%	2017 Canada kg ai	%
Phosphonic Acids, Phosphinic Acids	9 397 901	56.1	965 225	27.5	59 212 012	44.8
Phenoxy Acids	1 699 479	10.2	4 027	0.1	5 068 497	3.8
Fatty Acids & Surfactants	1 177 517	7.0	108 294	3.1	5 884 969	4.5
Triazoles	459 077	2.7	26 654	0.8	1 373 331	1.0
Benzonitriles	456 748	2.7	96 471	2.7	2 155 639	1.6
Hydrocarbons	398 003	2.4	489	0.0	7 250 137	5.5
Halogenated Organic Acids	382 751	2.3	916	0.0	85 377	0.1
Others	301 146	1.8	191 782	5.5	2 161 366	1.6
Acylureas	287 226	1.7	47 213	1.3	3 958 650	3.0
Carbamates	250 054	1.5	18 712	0.5	238 701	0.2
Ammoniums, Quaternary	230 894	1.4	69 740	2.0	1 596 722	1.2
Dinitrobenzenes	226 967	1.4	27 547	0.8	1 672 886	1.3
Azoles, Oxazoles, Thiazoles	195 019	1.2	20 318	0.6	670 736	0.5
Oils, Mineral and Vegetable	156 018	0.9	179 773	5.1	2 414 987	1.8
Anilides, Anilines	155 310	0.9	237 055	6.8	1 825 766	1.4
Cyclohexanedione oximes	151 966	0.9	2 054	0.1	343 404	0.3
Methoxyacrylates	144 335	0.9	19 694	0.6	631 903	0.5
Guanidines	133 323	0.8	16 722	0.5	401 502	0.3
Aryloxyphenoxyl Acids	80 175	0.5	163 868	4.7	302 983	0.2

Biscarbamates	70 343	0.4	136 331	3.9	2 071 908	1.6
Inorganics, Other	62 111	0.4	334 842	9.5	21 701 889	16.4
Benzoic Acid & Derivatives	57 695	0.3	35 975	1.0	311 354	0.2
Sulfonylureas	47 518	0.3	2 856	0.1	84 537	0.1
Imidazolinones	39 831	0.2	6 948	0.2	397 641	0.3
Triazines, Tetrazines	34 999	0.2	29 990	0.9	570 392	0.4
Benzamides	34 625	0.2	83 532	2.4	356 658	0.3
Amides	28 229	0.2	18 487	0.5	647 497	0.5
Dithiophosphates	20 622	0.1	23 100	0.7	XXX	
Thiophosphates	13 404	0.1	14 355	0.4	316 690	0.2
Morpholines & Oxathiines	11 671	0.1	4 127	0.1	XXX	
Pyrethroids, Pyrethrins	10 284	0.1	21 156	0.6	133 993	0.1
Urea Derivatives	8 685	0.1	28 027	0.8	313 836	0.2
Organic Acids	5 282	0.0	10 819	0.3	188 172	0.1
Pyridines	4 759	0.0	2 626	0.1	34 487	0.03
Organochlorines	3 577	0.0	30 610	0.9	XXX	
Microbials	3 253	0.0	189 506	5.4	0**	
Alcohols	1 468	0.0	2 823	0.1	1 677 345	1.3
Phosphates	943	0.0	1 983	0.1	XXX	
Diazines	814	0.0	4 712	0.1	28 637	0.02
Phthalic Acids	227	0.0	44 438	1.3	288 617	0.2
Inorganic Zincs	216	0.0	NS		NS	
Nitrobenzenes	94	0.0	28 471	0.8	123 857	0.1
Phosphoramidothioates	51	0.0	2 258	0.1	XXX	
Pheremones	13	0.0	1 421	0.04	1 952	0.0
Aldehydes	7	0.0	26 821	0.8	1 244 662	0.9
Organometallics	5	0.0	0	0.0	XXX	
Chromenones	3	0.0	3	0.0	40	0.0
Indanediones	2	0.0	1	0.0	XXX	
Phenols/Chlorophenols	NS		215	0.01	361 206	0.3
Chlorotriazines	NS		59 118	1.7	XXX	
Dithiocarbamates	NS		168 085	4.8	1 304 242	1.0
Thiocarbamates	NS		296	0.01	XXX	
Oxime carbamates	NS		21	0.0	XXX	
Organohalogens	NS		550	0.02	20 506	0.02
Total	**16 744 639**	**100.0**	**3 511 057**	**100.0**	**132 135 115**	**100.0**

NS – No sales reported

XXX – Indicates confidential business information. There were less than 4 registrants supplying data for these products.

**PMRA does not calculate active ingredient for Microbials because different units of active ingredient measures are used for product guarantees.

Quebec

The most recent sales data from Quebec is from 2018 (Table 16) (Ministère de l'Environnement, 2020). Quebec pesticide sales in that year amounted to 3.51 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 2018 was 16.7 million kg of active ingredient, almost five times that of Quebec's.

Quebec only uses chemical groups to report on pesticide sales instead of individual active ingredients. Their top five groups are the Phosphonic/Phosphinic Acids (27.5%), Inorganics (9.5%), Anilides/Anilines (6.8%), Others (5.5%), Microbials (5.4%), and Mineral and Vegetable Oils (5.1%). In Alberta, the top five chemical groups in sales are the Phosphonic/Phosphinic Acids (56.1%), Phenoxy acids (10.2%), Fatty Acids and Surfactants (7.0%), Triazoles (2.7%), and Benzonitriles (2.7%) (Table 16). This comparison illustrates that the makeup of products sold in Quebec and Alberta is dominated by the Phosphonic/Phosphinic acids (primarily glyphosate), but diverge after that. Phenoxy acids (mainly 2,4-D & MCPA) were also previously heavily used in both provinces, but sales of this group in Quebec has decreased substantially (from almost 190 000 kg ai in 2011 to just over 4 000 kg ai in 2018). Other than the Phosphonic/Phosphonic Acid group, the remaining high volume chemical groups were considerably different.

4.3 Selected Sales

Overall, the pesticide sales in 2018 do not show large shifts in products, other than some newer products that came on the market since the 2013 survey.

Herbicides sold into the agricultural sector was still dominated by glyphosate (almost 52% of ag herbicide sales), followed by glufosinate and the phenoxy herbicide MCPA at just under 6% of sales. The use of glyphosate as a multi-purpose herbicide appears to have leveled off, with other products that serve similar purposes (in crop and pre-harvest weed control) increasing (glufosinate and diquat).

In 2018, insecticides accounted for only 1.5%% of all agricultural use. Sales of the neonicotinoid insecticides used on treated seed (clothianidin, thiamethoxam and imidacloprid) were first reported in 2013, with a total of 62 586 kg ai sold. These three products made up over 54% of total agricultural insecticide sales in 2018, with 130 564 kg ai sold. Quebec reported that 2 887 kg ai of neonicotinoids were sold in 2018.

These products are currently under review by the PMRA, and may be restricted in their uses for seed treatment in the future. Chlorpyrifos, which had historically been the largest insecticide by sales, fell to the seventh position in 2018, at 5.5% of sales.

Fungicides accounted for 5.8% of agricultural sales, and was dominated by the Azole group (prothioconazole, propiconazole, tebuconazole, difenoconazole, metconazole, and thiabendazole). These products are used in foliar applications for the control of fusarium on cereals, and sclerotinia on oilseeds. They are also used in a wide variety of seed treatment compounds for numerous seedling diseases.

5.0 CONCLUSIONS

The overview of 2018 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 2013.

Key results of the 2018 survey are:

- Total sales volume was over **16.7** million kg of active ingredient.
- Herbicides and plant growth regulators made up **82.2%** of the total volume sold.
- Of the chemical groups, the Phosphonic/Phosphinic Acid group had the highest sales, comprising **56.1%** of total pesticide sales.
- From this chemical group, glyphosate sales accounted for **8.4** million kg ai, 50.0% of total sales, a slight decrease from 2013's total of 8.7 million kg ai.
- The Agriculture sector accounted for **95.8%** of all pesticides sold in Alberta, with 72% of that being herbicides, and 5.8% being fungicides. Adjuvants accounted for 10.3% of sales in this sector.
- The Commercial/Industrial sector accounted for **2.1%** of all pesticides sold in Alberta, with herbicides making up 71.7% and fungicides 10.8%.
- The Domestic sector accounted for **2.0%** of total pesticide sales, with herbicides making up 80.7% and insecticides 14.4% of that sector.

- Spatially, the Oldman, Red Deer, North 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 **36%**. The Lower Athabasca region had the lowest proportion of sales at **0.4%** of pesticide sales.
- The Central Parkland natural region had the largest volume of sales by natural region, at over **6.5** million kg ai.
- Average agricultural pesticide use intensity for Alberta was estimated at **1.37** kg ai/ha.

6.0 REFERENCES

AAF. 2018 Census of Agriculture for Alberta. Provincial Highlights. Alberta Agriculture and Rural Development, Statistics and Data Development, Agdex 852-8. Edmonton. 4 pp.

AAF. 2018. Crop Protection 2018. Agdex 606-1. Alberta Agriculture and Forestry. Edmonton. 596 pp.

AAFRD. 2002. 2001 Census of Agriculture for Alberta. I.D., M.D. and County Data by Region. Alberta Agriculture, Food and Rural Development, Statistics and Data Development. Agdex 852-1. Edmonton. 153 pp.

AARD. 2009. 2006 Census of Agriculture for Alberta. I.D., M.D. and County Data by Region. Alberta Agriculture and Rural Development. Statistics and Data Development. Agdex 852-1. Edmonton. 165 pp.

AARD. 2014. 2011 Census of Agriculture for Alberta. I.D., M.D. and County Data by Region. Alberta Agriculture and Rural Development. Statistics and Data Development. Agdex 852-6. Edmonton. 174 pp.

Alberta Environment and Parks. 2015. Overview of 2013 Pesticide Sales in Alberta. Land Policy Branch. Edmonton. 80 pp.

Anderson, A-M. 2005. Overview of Pesticide Data in Alberta Surface Waters Since 1995. Alberta Environment, Monitoring and Evaluation Branch, Edmonton, 172 pp.

Byrtus, G. 2000. Overview of 1998 Pesticide Sales in Alberta. Alberta Environment. Edmonton. 58 pp.

Byrtus, G. 2007. Overview of 2003 Pesticide Sales in Alberta. Alberta Environment. Edmonton. 60 pp.

Byrtus, G. 2011. Overview of 2008 Pesticide Sales in Alberta. Alberta Environment. Edmonton. 81 pp.

Cotton, M.M. and G. Byrtus. 1995. Pesticide Sales Trends in Alberta. Appendix A2. 66 pp *in* Cross, P. et al. Phase 2. Selection of Soil Landscape Units and Study Design

Considerations for the Surface Water Quality Monitoring Program. Prepared for CAESA Water Quality Monitoring Committee. Edmonton.

CAESA. 1998. Agricultural Impact on Water Quality in Alberta: An Initial Assessment. Prepared for Canada-Alberta Environmentally sustainable Agriculture Water Quality Committee. Alberta Agriculture, Food and Rural Development. Lethbridge. 95 pp.

Dion, S. 2007. Guide de classement des ingredients actifs par groups chimiques, Quebec ministere du Developpement durable, de l'Environnement et des Parcs, 35 pp.

Ecological Stratification Working Group. 1995. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. 121 pp report and national map at 1:7 500 000 scale.

Gregoire, F. 1997. Overview of 1995 Pesticide Sales in Quebec. Quebec Department of Environment and Wildlife, Pesticides Division. 19 pp.

Land Use Secretariat. 2008. Land-Use Framework. Government of Alberta. Edmonton. 54 pp.

Ministère de l'Environnement et de la Lutte contre les changements climatiques. Bilan des ventes de pesticides au Québec – Année 2018. [En ligne], Québec, 2020, 81 p. [www.environnement.gouv.qc.ca/pesticides/bilan/index.htm]

Pekalski, B. 1995. A Historical Series of Agricultural Statistics for Alberta: Selected Statistics from the Census of Agriculture. Alberta Agriculture, Food and Rural Development, Market Analysis and Statistics Branch. Edmonton, AB 33 pp.

Pest Management Regulatory Agency (PMRA). 2019. Pest Control Products Sales Report for 2017. Ottawa. 49 pp.

Spiess, D. 2005. Alberta Agriculture and Forestry, Resource Data Management Unit. Personal communication.

Strong, W.L. and J.M. Thompson. 1995. Ecodistricts of Alberta: Summary of Biophysical Attributes. Prepared for Alberta Environmental Protection, Edmonton. 92 pp. + maps.

APPENDICES

Appendix 1. Chemical Groups and Active Ingredients - 2018

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Acylureas	BENTAZON	Herbicide
	BROMACIL	Herbicide
	CYMOXANIL	Fungicide
	HEXAZINONE	Herbicide
	IPRODIONE	Fungicide
	NOVALURON	Insecticide
	TERBACIL	Herbicide
Alcohols	ALCOHOLS, C9-11, ETHOXYLATED	Adjuvant
	BUTOXYPOLYPROPYLENE GLYCOL	Insecticide
	P-MENTHANE-3, 8-DIOL	Insecticide
	SILOXYLATED POLYETHER	Adjuvant
Aldehydes	METALDEHYDE	Insecticide
Amides	CAPSAICIN (OLEORESIN CAPSICUM)	Vertebrate
	DAMINOZIDE	PGR
	ISOFETAMID	Fungicide
	MANDIPROPAMID	Fungicide
	NAPROPAMIDE	Herbicide
	PIPERINE	Vertebrate
	SAFLUFENACIL	Herbicide
Ammoniums, Quaternary	CHLORMEQUAT	PGR
	DENATONIUM BENZOATE	Vertebrate
	DIDECYL DIMETHYL AMMONIUM CHLORIDE	A-M
	DIFENZOQUAT	Herbicide
	DIQUAT	Herbicide
	N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	A-M
	N-ALKYL DIMETHYL ETHYLBENZYL AMMONIUM CHLORIDE	A-M
	PARAQUAT	Herbicide
Anilides, Anilines	AMITRAZ	Insecticide
	BOSCALID	Fungicide
	FENHEXAMID	Fungicide
	FLUMIOXAZIN	Herbicide
	FLUXAPYROXAD	Fungicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	METALAXYL	Fungicide
	METALAXYL-M	Fungicide
	PENFLUFEN	Fungicide
	PENTHIOPYRAD	Fungicide
	SEDAXANE	Fungicide
	S-METOLACHLOR	Herbicide
Aryloxyphenoxyl Acids	CLODINAFOP-PROPARGYL	Herbicide
	FENOXAPROP-P-ETHYL	Herbicide
	FLUAZIFOP-P-BUTYL	Herbicide
	QUIZALOFOP P-ETHYL	Herbicide
Azoles, Oxazoles, Thiazoles	4-CHLOROINDOLE-3-ACETIC ACID	Herbicide
	CLOMAZONE	Herbicide
	CHLORFENAPYR	Insecticide
	ETRIDIAZOLE	Fungicide
	FENPYROXIMATE	Insecticide
	FLUDIOXONIL	Fungicide
	OXATHIAPIPROLIN	Fungicide
	PINOXADEN	Herbicide
	PYRASULFOTOLE	Herbicide
	PYROXASULFONE	Herbicide
	SPIROTETRAMAT	Insecticide
	STRYCHNINE	Vertebrate
	THIABENDAZOLE	Fungicide
	TOPRAMEZONE	Herbicide
Benzamides	CHLORANTRANILIPROLE	Insecticide
	CYANTRANILIPROLE	Insecticide
	DEET	Insecticide
	FLUOPICOLIDE	Fungicide
	FLUOPYRAM	Fungicide
	PROPYZAMIDE	Herbicide
Benzoic Acid & Derivatives	BISPYRIBAC	Herbicide
	DICAMBA	Herbicide
	METHYL ANTHRANILATE	Vertebrate
	QUINCLORAC	Herbicide
Benzonitriles	BROMOXYNIL	Herbicide
	CHLOROTHALONIL	Fungicide
	DICHLOBENIL	Herbicide
Biscarbamates	DESMEDIPHAM	Herbicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	MANCOZEB	Fungicide
	METIRAM	Fungicide
	PHENMEDIPHAM	Fungicide
	THIOPHANATE-METHYL	Fungicide
	THIRAM	Fungicide
Carbamates	BIFENAZATE	Insecticide
	CARBARYL	Insecticide
	CHLORPROPHAM	Herbicide
	EPTC	Herbicide
	ICARIDIN	Insecticide
	METHOMYL	Insecticide
	OXADIAZON	Herbicide
	POLYOXIN D ZINC SALT	Fungicide
	PROPAMOCARB HYDROCHLORIDE	Fungicide
	PROPOXUR	Insecticide
	TRIALLATE	Herbicide
Chromenones	BRODIFACOUM	Vertebrate
	BROMADIOLONE	Vertebrate
	DIFETHIALONE	Vertebrate
	WARFARIN	Vertebrate
Cyclohexanedione Oximes	CLETHODIM	Herbicide
	SETHOXYDIM	Herbicide
	TEPRALOXYDIM	Herbicide
	TRALKOXYDIM	Herbicide
Diazines	6-BENZYLAMINOPURINE	PGR
	AMINOCYCLOPYRACHLOR	Herbicide
	ANCYMIDOL	PGR
	BUPROFEZIN	Insecticide
	MALEIC HYDRAZIDE	PGR
	PYRAZON	Herbicide
	PYRIDABEN	Insecticide
Dinitrobenzenes	BROMETHALIN	Vertebrate
	ETHALFLURALIN	Herbicide
	FLUAZINAM	Fungicide
	PENDIMETHALIN	Herbicide
	TRIFLURALIN	Herbicide
Dithiophosphates	DIMETHOATE	Insecticide
	MALATHION	Insecticide
	PHORATE	Insecticide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Fatty Acids & Surfactants	AMMONIUM SOAP OF FATTY ACID	Herbicide
	FATTY ACID	Herbicide
	NONYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	OCTADEC-9-ENOIC ACID	Adjuvant
	OCTYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	PARAFFIN BASE MINERAL OIL (ADJUVANT)	Adjuvant
	PARAFFIN BASE PETROLEUM OIL	Adjuvant
	POLY[OXYETHYLENE(DIMETHYLIMINIO)ETHYLENE(DIMETHYLIMINIO)ETHYLENE DICHLORIDE]	A-M
	POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adjuvant
	POTASSIUM SALTS OF FATTY ACIDS	Insecticide
	SOAP (INSECTICIDAL)	Insecticide
	SURFACTANT BLEND	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
Halogenated Organic Acids	AMINOPYRALID	Herbicide
	CLOPYRALID	Herbicide
	CYFLUMETOFEN	Insecticide
	FLUROXYPYR	Herbicide
	HALAUXIFEN	Herbicide
	PICLORAM	Herbicide
Hydrocarbons	ASPHALT SOLIDS	Fungicide
	PETROLEUM HYDROCARBON BLEND	Adjuvant
	POLYMERIZED BUTENES	Vertebrate
Imidazolinones	FENAMIDONE	Fungicide
	IMAZAMETHABENZ	Herbicide
	IMAZAMOX	Herbicide
	IMAZETHAPYR	Herbicide
	IMAZAPYR	Herbicide
Indanediones	CHLOROPHACINONE	Vertebrate
	DIPHACINONE	Vertebrate
Inorganic Zincs	ZINC NAPHTHENATE	Wood

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Inorganics, Other	ALUMINUM PHOSPHIDE	Insecticide
	BORACIC ACID	Insecticide
	BORAX	Insecticide
	CALCIUM HYPOCHLORITE	A-M
	CALCIUM POLYSULPHIDE	Fungicide
	COPPER (CUPRIC) HYDROXIDE	Fungicide
	COPPER (PRESENT AS COPPER OCTANOATE)	Fungicide
	COPPER NAPHTHENATE	Wood
	COPPER OXYCHLORIDE	Fungicide
	COPPER SULPHATE	Fungicide
	COPPER SULPHATE TRIBASIC	Fungicide
	CUPROUS OXIDE (COPPER AS ELEMENTAL)	A-M
	DISODIUM OCTOBORATE TETRAHYDRATE	Wood
	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	A-M
	SILICA AEROGEL	Insecticide
	SILICON DIOXIDE FRESH WATER FOSSILS	Insecticide
	SILICON DIOXIDE SALT WATER FOSSILS	Insecticide
	SODIUM CHLORIDE	Herbicide
	SODIUM HYPOCHLORITE	Fungicide
	SULPHUR (FUNGICIDE)	Fungicide
	SULPHUR (VERTEBRATE CONTROL)	Vertebrate
Methoxyacrylates	AZOXYSTROBIN	Fungicide
	FLUOXASTROBIN	Fungicide
	MANDESTROBIN	Fungicide
	PICOXYSTROBIN	Fungicide
	PYRACLOSTROBIN	Fungicide
	TRIFLOXYSTROBIN	Fungicide
Microbials	*BACILLUS AMYLOLIQUEFACIENS,* STRAIN F747	Fungicide
	BACILLUS FIRMUS I-1582	Insecticide
	BACILLUS SPHAERICUS	Insecticide
	BACILLUS SUBTILIS (MB1600)	Fungicide
	BACILLUS SUBTILIS (QT713)	Insecticide
	BACILLUS THURINGIENSIS SSP KURSTAKI	Insecticide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	BACILLUS THURINGIENSIS, SEROTYPE H-14	Insecticide
	BEAUVARIA BASSIANA STRAIN ANT 03	Insecticide
	BEAUVERIA BASSIANA STRAIN GHA	Insecticide
	CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	Fungicide
	GLIOCLADIUM CATENULATUM	Fungicide
	METARHIZIUM ANISOPLIAE (STRAIN F52)	Insecticide
	STREPTOMYCES GRISEOVIRIDIS	Fungicide
	STREPTOMYCES LYDICUS	Fungicide
	TRICHODERMA ASPERELLUM, STRAIN T34	Fungicide
	TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	Fungicide
Morpholines & Oxathiines	CARBATHIIN	Fungicide
Nitrobenzenes	MESOTRIONE	Fungicide
Oils, Mineral and Vegetable	CANOLA OIL	Insecticide
	GARLIC OIL	Insecticide
	METHYLATED SEED OIL OF SOYBEAN	Adjuvant
	MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insecticide
	TEA TREE OIL	Fungicide
	THYMOL	Insecticide
Organic Acids	ABAMECTIN	Insecticide
	ACEQUINOCYL	Insecticide
	ACETIC ACID	Herbicide
	AZADIRACHTIN	Insecticide
	CITRIC ACID	A-M
	FERRIC SODIUM EDTA	Insecticide
	FORMIC ACID	Insecticide
	GIBBERELLIC ACID	PGR
	OXALIC ACID DIHYDRATE	Insecticide
	PERACTIC ACID	A-M
	PROHEXADIONE CALCIUM	PGR
	SPINETORAM	Insecticide
	SPINOSAD FACTOR A PLUS	Insecticide
	SPIROMESIFEN	Insecticide
	TRINEXAPAC-ETHYL	PGR
Organochlorines	PARADICHLOROBENZENE	Insecticide
Organometallics	FENBUTATIN OXIDE	Insecticide
Others	3-DECEN-2-ONE	PGR
	ACROLEIN	Herbicide
	CELLULOSE (FROM POWDERED CORN COBS)	Vertebrate
	CORN GLUTEN MEAL	Herbicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	DRIED BLOOD	Vertebrate
	ETHOFUMESATE	Herbicide
	ETHYLENE	PGR
	EXTRACT OF *REYNOUTRIA SACHALINENSIS*	Fungicide
	GARLIC POWDER	Fungicide
	METHYL NONYL KETONE	Vertebrate
	NATURAL GUM RESINS	Insecticide
	PIPERONYL BUTOXIDE	Insecticide
	SODIUM ALPHA-OLEFIN SULFONATE	Adjuvant
Phenoxy Acids	2,4-D	Herbicide
	2,4-DB	Herbicide
	4-CPA	PGR
	DICHLORPROP	Herbicide
	DICHLORPROP-P	Herbicide
	MCPA	Herbicide
	MECOPROP-P	Herbicide
	TRICLOPYR	Herbicide
Pheromones	1-OCTEN-3-OL	Insecticide
	S-KINOPRENE	Insecticide
	S-METHOPRENE	Insecticide
	Z-9-TRICOSENE	Insecticide
Phosphates	DICHLORVOS	Insecticide
	NALED	Insecticide
	TETRACHLORVINPHOS	Insecticide
Phosphonic Acids, Phosphinic Acids	ETHEPHON	PGR
	GLUFOSINATE AMMONIUM	Herbicide
	GLYPHOSATE	Herbicide
	MONO- AND DI-POTASSIUM SALT OF PHOSPHOROUS ACID	Fungicide
Phosphoramidothioates	ACEPHATE	Insecticide
Phthalic Acids	CAPTAN	Fungicide
	N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insecticide
Pyrethroids, Pyrethrins	ALLETHRIN	Insecticide
	BETA-CYFLUTHRIN	Insecticide
	BIFENTHRIN	Insecticide
	CYFLUTHRIN	Insecticide
	CYHALOTHRIN-LAMBDA	Insecticide
	CYPERMETHRIN	Insecticide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	D-CIS, TRANS ALLETHRIN	Insecticide
	DELTAMETHRIN	Insecticide
	D-PHENOTHRIN	Insecticide
	D-TRANS ALLETHRIN	Insecticide
	FLUVALINATE	Insecticide
	METOFLUTHRIN	Insecticide
	PERMETHRIN	Insecticide
	PRALLETHRIN	Insecticide
	PYRETHRIN	Insecticide
	TEFLUTHRIN	Insecticide
	TETRAMETHRIN	Insecticide
Pyridines	4-AMINOPYRIDINE	Vertebrate
	ACETAMIPRID	Insecticide
	DI-N-PROPYL ISOCINCHOMERONATE	Insecticide
	FLONICAMID	Insecticide
	PYRIPROXYFEN	Insecticide
	SULFOXAFLOR	Insecticide
Sulfonylureas	CHLORSULFURON	Herbicide
	ETHAMETSULFURON-METHYL	Herbicide
	FLUCARBAZONE SODIUM	Herbicide
	HALOSULFURON	Herbicide
	METSULFURON-METHYL	Herbicide
	NICOSULFURON	Herbicide
	RIMSULFURON	Herbicide
	THIFENSULFURON METHYL	Herbicide
	TRIBENURON METHYL	Herbicide
	TRIFLUSULFURON METHYL	Herbicide
Thiophosphates	CHLORPYRIFOS	Insecticide
	DIAZINON	Insecticide
Triazines, Tetrazines	ATRAZINE	Herbicide
	CYROMAZINE	Insecticide
	INDAZIFLAM	Herbicide
	METRIBUZIN	Herbicide
	PROMETRYNE	Herbicide
	PYMETROZINE	Insecticide
	SIMAZINE	Herbicide
	THIENCARBAZONE METHYL	Herbicide
	TRICHLORO-S-TRIAZINETRIONE	A-M
Triazoles	AMETOCTRADIN	Fungicide
	AMITROLE	Herbicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	CARFENTRAZONE-ETHYL	Herbicide
	DIFENOCONAZOLE	Fungicide
	FLORASULAM	Herbicide
	IPCONAZOLE	Herbicide
	METCONAZOLE	Fungicide
	MYCLOBUTANIL	Fungicide
	PACLOBUTRAZOL	PGR
	PROPICONAZOLE	Fungicide
	PROTHIOCONAZOLE	Fungicide
	PYROXSULAM	Herbicide
	SULFENTRAZONE	Herbicide
	TEBUCONAZOLE	Fungicide
	TRITICONAZOLE	Fungicide
	UNICONAZOLE-P	PGR
Urea Derivatives	1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN	A-M
	CYAZOFAMID	Herbicide
	DIFLUFENZOPYR-SODIUM	Herbicide
	DIURON	Herbicide
	LINURON	Herbicide

A-M – Anti-Microbial
PGR – Plant Growth Regulator
Wood – Wood preservative

Appendix 2. 1998, 2003, 2008, 2013 and 2018 Pesticide Sales by Active Ingredient

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
GLYPHOSATE	Herb	8 370 396	50.0	8 726 904.1	57.3	6 235 498.5	50	3 419 822.1	36.9	2 682 748.9	28.9
GLUFOSINATE AMMONIUM	Herb	950 680	5.7	694 496.1	4.6	395 681.1	3.2	107 255.5	1.2	63 863.8	0.7
MCPA	Herb	926 878	5.5	920 433.3	6.0	1 028 995.8	8.2	1 097 359.0	11.8	885 239.1	9.5
SURFACTANT BLEND	Adj	762 968	4.6	300 914.3	2.0	403 438.3	3.2	438 235.7	4.7	496 561.7	5.4
2,4-D	Herb	719 973	4.3	641 171.0	4.2	973 082.3	7.8	763 357.7	8.2	777 764.0	8.4
PETROLEUM HYDROCARBON BLEND	Adj	397 956	2.4	215 138.9	1.4	656 588.2	5.3	559 728.7	6	368 704.3	4
BROMOXYNIL	Herb	367 728	2.2	315 622.8	2.1	330 177.1	2.6	354 906.6	3.8	268 105.3	2.9
BENTAZON	Herb	264 765	1.6	117 357.2	0.8	20 481.0	0.2	21 986.9	0.24	12 066.2	0.1
FLUROXYPYR	Herb	263 093	1.6	158 114.3	1.0	71 814.1	0.6	43 166.7	0.47	23 700.8	0.3
CORN GLUTEN MEAL	Herb	233 369	1.4	330 967.4	2.2	705.6	0.006				
TRIALLATE	Herb	222 547	1.3	367 416.9	2.4	101 072.2	0.8	197 221.4	2.1	692 497.5	7.5
DIQUAT	Herb	173 774	1.0	61 204.4	0.4	34 893.9	0.3	25 524.4	0.28	21 765.0	0.2
ETHALFLURALIN	Herb	171 059	1.0	87 128.4	0.6	82 873.7	0.7	168 135.0	1.8	452 294.4	4.9
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adj	140 892	0.8	97 257.9	0.6	55 943.9	0.4	13 727.9	0.15	9 340.0	0.1
PARAFFIN BASE PETROLEUM OIL	Adj	139 836	0.8	62 188.2	0.4	22 939.3	0.2	27 958.4	0.3	77 427.2	0.8
PROTHIOCONAZOLE	Fung	133 418	0.8	81 609.0	0.5	26 517.0	0.2				
PROPICONAZOLE	Fung	109 726	0.7	119 339.7	0.8	50 387.5	0.4	13 183.4	0.14	5 664.4	0.06
CHLOROTHALONIL	Fung	88 288	0.5	65 366.9	0.4	35 693.8	0.3	43 208.6	0.47	37 334.0	0.4
TRALKOXYDIM	Herb	81 794	0.5	57 531.4	0.4	147 916.9	1.2	141 226.1	1.5	126 323.5	1.4
TEBUCONAZOLE	Fung	81 644	0.5	121 566.7	0.8	15 549.0	0.1	5 922.4	0.06		
CLOPYRALID	Herb	76 390	0.5	69 351.3	0.5	58 339.1	0.5	56 618.0	0.61	59 019.7	0.6
NONYLPHENOXYPOLYETHOXYETHANOL	Adj	72 559	0.4	38 615.1	0.3	58 634.2	0.5	59 558.8	0.64	94 247.3	1.0
PINOXADEN	Herb	70 359	0.4	66 942.7	0.4	32 783.2	0.3				
PARAFFIN BASE MINERAL OIL	Adj	67 265	0.4	45 772.7	0.3	188 738.7	1.5	192 634.4	2.1	193 162.6	2.1

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
METHYLATED SEED OIL OF SOYBEAN	Adj	65 174	0.4								
CLOTHIANIDIN	Insect	61 385	0.4	28 024.6	0.2	686.8	0.006				
PYRAFLUFEN-ETHYL	Herb	61 293	0.4								
AZOXYSTROBIN	Fung	58 895	0.4	24 967.3	0.2	4 899.6	0.04	1 961.1	0.02		
MANCOZEB	Fung	58 848	0.4	17 758.5	0.1	22 355.4	0.2	36 127.2	0.39	45 813.9	0.5
CHLORMEQUAT	PGR	56316	0.3	472.9	0.003	54.3	0	89.7	0	62.3	0
ACROLEIN	Herb	54 102	0.3	10 367.8	0.07	9 051.0	0.07	16 981.4	0.18	17 520.5	0.2
DICAMBA	Herb	54 010	0.3	54 119.6	0.4	94 677.9	0.8	121 422.7	1.3	138 278.6	1.5
PYRACLOSTROBIN	Fung	52 735	0.3	63 402.0	0.4	7 650.5	0.06	1 263.6	0.01		
TRIFLURALIN	Herb	52 207	0.3	23 772.0	0.2	34 730.5	0.3	40 654.3	0.44	230 028.2	2.5
THIAMETHOXAM	Insect	50 658	0.3	24 992.3	0.2	5 513.7	0.04	1 176.2	0.01		
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insect	49 078	0.3	11 819.4	0.08	3 897.7	0.03	2 233.7	0.02	3 477.4	0.04
MONO- AND DI-POTASSIUM SALT OF PHOSPHOROUS ACID	Fung	45 466	0.3								
BENZOVINDIFLUPYR	Fung	43 213	0.3								
CLETHODIM	Herb	40 190	0.2	30 141.6	0.2	19 955.8	0.2	3 694.9	0.04	2 490.7	0.03
BOSCALID	Fung	38 506	0.2	36 006.9	0.2	20 519.8	0.2				
PYROXSULAM	Herb	38 059	0.2	19 162.1	0.1	1 251.4	0.01				
FENOXAPROP-P-ETHYL	Herb	37 057	0.2	54 295.9	0.4	58 399.7	0.5	64 212.1	0.69	59 919.0	0.6
DIFENOCONAZOLE	Fung	36 271	0.2	14 944.4	0.1	13 599.3	0.1	11 067.6	0.12		
MECOPROP-P	Herb	31 177	0.2	30 815.6	0.2	43 319.9	0.3				
SETHOXYDIM	Herb	29 978	0.2	2 142.2	0.01	19 194.1	0.2	30 993.1	0.33	58 678.5	0.6
SAFLUFENACIL	Herb	27 620	0.2	7 098.2	0.05						
TRIBENURON METHYL	Herb	26 907	0.2	13 178.7	0.09	9 956.1	0.08	5 404.8	0.06	6 763.6	0.07
TRIGLYCERIDE ETHOXYLATE 10 POE	Adj	25 550	0.2	36 637.6	0.2						
CLODINAFOP-PROPARGYL	Herb	25 339	0.2	30 330.7	0.2	46 882.3	0.4	49 520.8	0.53	34 408.9	0.4
EPTC	Herb	24 272	0.1	5 688.0	0.04	11 024.0	0.09	11 944.0	0.13	38 574.2	0.4
HALAUXIFEN	Herb	23 850	0.1								

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
MONO- AND DIBASIC SODIUM, POTASSIUM, AND AMMONIUM PHOSPHITES	Fung	23 819	0.1	4 030.7	0.03						
CYANTRANILIPROLE	Insect	23 075	0.1								
METCONAZOLE	Fung	22 689	0.1	19 637.1	0.1						
PYRASULFOTOLE	Herb	22 064	0.1	28 218.1	0.2	6 323.6	0.05				
TRIFLOXYSTROBIN	Fung	22 039	0.1	4 443.8	0.03	7 982.0	0.06				
IMAZAMOX	Herb	21 273	0.1	12 443.4	0.08	7 773.9	0.06	3 122.0	0.03	4 231.8	0.05
SILICON DIOXIDE SALT WATER FOSSILS	Insect	20 779	0.1	16 305.1	0.1	15 624.1	0.1	15 588.2	0.17	47 025.2	0.5
SEDAXANE	Fung	20 664	0.1	3 395.0	0.02						
ATRAZINE	Herb	19 198	0.1	3 048.5	0.02	6 172.7	0.05	4 654.5	0.05	5 753.8	0.06
IMIDACLOPRID	Insect	18 680	0.1	9 595.5	0.06	647.1	0.005	978.0	0.01	9.5	0
FLUXAPYROXAD	Fung	18 083	0.1	9 534.0	0.06						
QUIZALOFOP P-ETHYL	Herb	17 777	0.1	10 837.2	0.07	3 673.0	0.03	4 461.0	0.05	2 669.7	0.03
IPRODIONE	Fung	17 648	0.1	62 602.7	0.4	57 374.1	0.5	21 014.3	0.23	9 592.7	0.1
CLOMAZONE	Herb	17 144	0.1								
SILICA AEROGEL	Insect	15 254	0.09	14 177.0	0.09	25 090.8	0.2	7 785.0	0.08	11 052.5	0.1
METALAXYL-M	Fung	15 183	0.09	11 010.3	0.07	4 357.1	0.03	29 813.1	0.32		
TRICLOPYR	Herb	13 606	0.08	33 441.5	0.2	25 678.1	0.2	33 116.2	0.36	30 311.8	0.3
CHLORPYRIFOS	Insect	13 269	0.08	36 526.5	0.2	82 728.7	0.7	197 765.5	2.1	217 397.5	2.3
FLORASULAM	Herb	13 244	0.08	15 564.3	0.1	15 760.4	0.1	6 090.5	0.07		
SULFENTRAZONE	Herb	12 775	0.08	4 342.4	0.03						
MALATHION	Insect	12 915	0.08	10 075.5	0.07	13 477.1	0.1	17 413.8	0.19	22 316.5	0.2
FLUDIOXONIL	Fung	12 120	0.07	26 640.8	0.2	1 100.6	0.009	24 377.7	0.26		
CARBATHIIN	Fung	11 655	0.07	19 119.5	0.1	15 231.1	0.1	45 228.3	0.49	122 292.0	1.3
METRIBUZIN	Herb	10 365	0.06	3 654.8	0.02	5 061.1	0.04	6 306.3	0.07	7 601.4	0.08
PICOXYSTROBIN	Insect	10 066	0.06	7 757.3	0.05						
IMAZAMETHABENZ	Herb	10 030	0.06	22 841.4	0.1	94 004.3	0.8	138 551.4	1.5	173 679.2	1.9
DEET	Insect	9 820	0.06	5 901.4	0.04	1 201.9	0.01	3 413.3	0.04	4 167.9	0.04

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
AMINOPYRALID	Herb	9 770	0.06	11 369.2	0.07	4 358.4	0.03				
PICLORAM	Herb	9 641	0.06	17 209.9	0.1	25 377.1	0.2	17 897.0	0.19	15 109.4	0.2
CELLULOSE (FROM POWDERED CORN COBS)	Vert	9 134	0.05	9 596.9	0.06						
METALAXYL	Fung	8 926	0.05	5 422.2	0.04	1 164.1	0.009	302.2	0	3 796.2	0.04
CARFENTRAZONE-ETHYL	Herb	8 302	0.05	2 219.4	0.01	2 694.4	0.02				
FLUCARBAZONE SODIUM	Herb	8 147	0.05	18 309.5	0.1	8 333.0	0.07	2 292.2	0.02		
PYROXASULFONE	Herb	8 036	0.05								
ETHEPHON	Fung	7 539	0.05	3 136.6	0.02	2 388.0	0.02	115.2	0	31.2	0
FERROUS SULFATE	Herb	6 695	0.04	180.2	0.001	7 846.5	0.06	1 593.4	0.02	1 818.7	0.02
THIRAM	Fung	6 491	0.04	15 129.5	0.1	76 081.8	0.6	27 136.3	0.29	22 791.7	0.2
FLUMIOXAZIN	Herb	6 196	0.04	548.1	0.004						
PHORATE	Insect	6 166	0.04	12 642.8	0.08	40 375.5	0.3	41 417.3	0.45	19 209.0	0.2
METSULFURON-METHYL	Herb	6 049	0.04	2 250.9	0.01	286.3	0.002	360.9	0	938.6	0.01
2,4-DB	Herb	5 752	0.03	5 123.5	0.03	3 640.0	0.03	11 501.4	0.12	20 950.3	0.2
OCTADEC-9-ENOIC ACID,	Adj	5 536	0.03	18 145.8	0.1						
IMAZAPYR	Herb	5 509	0.03	7 023.7	0.05	3 828.1	0.03	1 710.0	0.02	200.6	0
THIFENSULFURON METHYL	Herb	5 409	0.03	6 338.3	0.04	8 344.1	0.07	8 572.3	0.09	13 697.5	0.1
LINURON	Herb	4 609	0.03	3 676.3	0.02	7 317.5	0.06	8 991.4	0.1	8754	0.09
COPPER (CUPRIC) HYDROXIDE	Fung	4 098	0.02	5 931.0	0.04	3 192.6	0.03	6 885.0	0.07	252.5	0
METIRAM	Fung	4 056	0.02	1 188.0	0.008	619.2	0.005	2 068.8	0.02	14 862.4	0.2
HEXAZINONE	Herb	3 977	0.02	3 177.0	0.02	3 540.2	0.03	940.9	0.01	2 428.1	0.03
CYHALOTHRIN-LAMBDA	Insect	3 872	0.02	6 170.5	0.04	2 947.5	0.02	5 124.4	0.06	1 097.9	0.01
PARADICHLOROBENZENE	Insect	3 577	0.02	122.3	0.0	508.5	0.004	13.9	0	65.3	0
PENFLUFEN	Fung	3 365	0.02	1 446.8	0.009						
PERMETHRIN	Insect	3 101	0.02	1 508.9	0.01	1 402.7	0.01	315.8	0	397.2	0
IMAZETHAPYR	Herb	3 017	0.02	2 946.9	0.02	6 195.7	0.05	5 063.2	0.05	10 528.6	0.1
FLUAZINAM	Fung	2 964	0.02	2 009.3	0.01						
IRON FeHEDTA	Herb	2 720	0.02	1 351.1	0.009						

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SILICON DIOXIDE FRESH WATER FOSSILS	Insect	2 468	0.01	280.0	0.002	29.0	0				
FORMIC ACID	Insect	2 456	0.01								
SULFOXAFLOR	Insect	2 450	0.01								
AMINOCYCLOPYRACHLOR	Herb	2 300	0.01								
ACETIC ACID	Herb	2 273	0.01	5 040.7	0.03	11 915.6	0.1	1 555.5	0.02		
PYRIMETHANIL	Fung	2 255	0.01	120.0	0.0						
CARBARYL	Insect	2 225	0.01	4 919.1	0.03	9 787.3	0.08	104 430.6	1.1	3 142.8	0.03
SULPHUR (FUNGICIDE)	Fung	2 195	0.01	1 122.4	0.007	1 523.2	0.01	2 968.1	0.03	7 315.4	0.08
FLUOPYRAM	Fung	2 097	0.01	2 175.3	0.01						
DIURON	Herb	2 096	0.01	21 644.1	0.1	37 674.4	0.3	31 096.3	0.34	9 919.3	0.1
POTASSIUM SALTS OF FATTY ACIDS	Insect	1 881	0.01	759.0	0.005	687.3	0.006				
SULPHUR (VERTEBRATE CONTROL)	Vert	1 875	0.01	726.4	0.005	11 404.8	0.09	185.4	0	1 045.3	0.01
BACILLUS FIRMUS I-1582	Insect	1 821	0.01	5.3	0.0						
DIMETHOATE	Insect	1 540	0.009	1 290.3	0.008	1 456.5	0.01	1 691.1	0.02	4 883.4	0.05
SIMAZINE	Herb	1 532	0.009	2 154.8	0.01	4 725.1	0.04	1 160.4	0.01	3 688.1	0.04
BORACIC ACID	Insect	1 516	0.009	403.8	0.003	135.8	0.001	41.6	0	322.7	0
CHLORANTRANILIPROLE	Insect	1 509	0.009	288.3	0.002						
DICHLORPROP-P	Herb	1 436	0.009								
TALLOW FATTY ACID AMINE ETHOXYLATE	Adj	1 421	0.008	2 266.9	0.01			138.1	0	3 272.2	0.04
DELTAMETHRIN	Insect	1 389	0.008	1 896.7	0.01	537.6	0.004	2 735.1	0.03	775.1	0.01
DIFLUFENZOPYR-SODIUM	Herb	1 348	0.008	474.0	0.003						
BISPYRIBAC	Herb	1 341	0.008	4.5	0	0.5	0				
AMITROLE	Herb	1 331	0.008	13 566.6	0.09	4 994.4	0.04	2 107.0	0.02	2 026.5	0.02
PIPERONYL BUTOXIDE	Insect	1 278	0.008	1 824.3	0.01	1 607.3	0.01	405.1	0	591.6	0.01
CALCIUM HYPOCHLORITE	A-M	1 263	0.008								
THIENCARBAZONE METHYL	Herb	1 244	0.007	765.0	0.005						
ALCOHOLS, C9-11, ETHOXYLATED	Adj	1 224	0.007	55 385.8	0.4						
PROMETRYNE	Herb	1 125	0.007	1 278.4	0.008	855.5	0.007	586.3	0.01		

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IPCONAZOLE	Fung	1 070	0.006	890.2	0.006						
BACILLUS THURINGIENSIS SSP ISRAELENSIS	Insect	1 047	0.006	1 550.2	0.01	62.2	0	34.4	0	294.2	0
MUSTARD SEED POWDER (*BRASSICA HIRTA*)	Vert	919	0.005					471.3	0.01		
BIFENTHRIN	Insect	902	0.005								
THIOPHANATE-METHYL	Fung	856	0.005	1 908.8	0.01	1 024.9	0.008	454.7	0	859.4	0.01
3-DECEN-2-ONE	PGR	815	0.005								
S-METOLACHLOR	Herb	787	0.005	262.3	0.002	830.9	0.007	3 278.9	0.04		
OCTYLPHENOXYPOLYETHOXYETHANOL	Adj	766	0.005	2 420.4	0.02	3 920.6	0.03	5 144.7	0.06	9 219.0	0.1
PENDIMETHALIN	Herb	737	0.004	883.8	0.006	1 003.2	0.008	782.8	0.01	1 061.1	0.01
INDAZIFLAM	Herb	737	0.004								
TRICHLORO-S-TRIAZINETRIONE	A-M	737	0.004								
DICHLOBENIL	Herb	732	0.004	617.6	0.004	572.3	0.005	684.7	0.01	728.2	0.01
TOPRAMEZONE	Herb	680	0.004	59.9	0.0						
NALED	Insect	670	0.004	578.1	0.004	823.0	0.007	972.6	0.01	1 257.9	0.01
MCPB	Herb	650	0.004	672.0	0.004	396.0	0.003	1 717.5	0.02	3 271.5	0.04
N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	A-M	634	0.004	85.2	0.0	148.0	0.001	163.4	0	63.7	0
AMMONIUM SOAP OF FATTY ACID	Herb	618	0.004	783.0	0.005						
1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN	A-M	609	0.004								
ETHABOXAM	Fung	604	0.004								
FLUOXASTROBIN	Fung	599	0.004								
SODIUM ALPHA-OLEFIN SULFONATE	Adj	583	0.003								
MALEIC HYDRAZIDE	PGR	581	0.003	658.3	0.004	867.8	0.007	1 952.7	0.02	551.7	0.01
THIABENDAZOLE	Fung	557	0.003	128.0	0.0	412.5	0.003	1 388.8	0.01	3 187.2	0.03
ICARDIN	Insect	554	0.003								
COPPER NAPHTHENATE	Wood	549	0.003	306.4	0.002	404.6	0.003	59.8	0	123.2	0
HYDROGEN PEROXIDE	Insect	529	0.003	107.3	0.0			996.8	0.01		

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RIMSULFURON	Herb	522	0.003	98.2	0.0	208.4	0.002	219.1	0	63.2	0
SOAP	Insect	515	0.003	452.4	0.003	1 331.8	0.01	947.2	0.01	1 211.1	0.01
TRITICONAZOLE	Fung	508	0.003	1 895.7	0.01	3 145.2	0.03	2 080.4	0.02		
TERBACIL	Herb	485	0.003	734.4	0.005	1 728.0	0.01	332.8	0	891.2	0.01
SPIROTETRAMAT	Insect	460	0.003	199.7	0.001	10.3	0				
STRYCHNINE	Vert	454	0.003	168.6	0.001	595.5	0.005	244.8	0	163.2	0
PROPAMOCARB HYDROCHLORIDE	Fung	385	0.002	1 510.2	0.01	540.1	0.004	411.9	0	1 271.3	0.01
ETHOFUMESATE	Herb	370	0.002	864.0	0.006	6 518.4	0.05	7 742.4	0.08	12 559.4	0.1
CALCIUM POLYSULPHIDE	Fung	351	0.002	653.8	0.004	564.6	0.005	364.8	0	224.0	0
BORAX	Insect	341	0.002	570.4	0.004	291.8	0.002	168.2	0	218.8	0
BROMACIL	Herb	328	0.002	4 485.6	0.03	2 486.9	0.02	4 770.3	0.05	3 106.9	0.03
POTASSIUM MONOPERSULPHATE	A-M	325	0.002	34.2	0.0	20.3	0	59.9	0	15.0	0
CYPRODINIL	Fung	324	0.002	37 172.2	0.2	0.9	0				
DRIED BLOOD	Vert	314	0.002	759.0	0.005	327.0	0.003				
MANDIPROPAMID	Fung	300	0.002	344.4	0.002						
TRIBASIC COPPER SULPHATE	Fung	285	0.002	249.7	0.002	375.9	0.003	130.9	0	159.6	0
OXALIC ACID DIHYDRATE	Insect	282	0.002								
AMITRAZ	Insect	278	0.002								
DICHLORVOS	Insect	263	0.002	209.1	0.001	254.6	0.002	193.5	0	335.2	0
NAPROPAMIDE	Herb	251	0.002	214.2	0.001	211.9	0.002	159.1	0	294.6	0
CHLORSULFURON	Herb	240	0.001	28.5	0.0	225.8	0.002	98.6	0	66.7	0
PYRETHRINS	Insect	237	0.001	133.6	0.0	240.0	0.002	220.9	0	178.2	0
TETRAMETHRIN	Insect	235	0.001	74.2	0.0	18.4	0	20.3	0	14.2	0
4-CHLOROINDOLE-3-ACETIC ACID, PRESENT AS POTASSIUM SALT	Herb	231	0.001								
POTASSIUM BICARBONATE	Fung	230	0.001	21.2	0.0						
TRIETHANOLAMINE SALTS OF FATTY ACIDS	Insect	219	0.001	278.6	0.002						
PYRAZON	Herb	216	0.001	27.1	0.0	72.2	0.001	338.0	0	1 204.9	0.01
ZINC NAPHTHENATE	Wood	216	0.001	146.1	0.001	153.5	0.001	23.6	0	40.0	0

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PROPYZAMIDE	Herb	212	0.001	617.3	0.004	475.7	0.004	179.4	0	272.0	0
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insect	201	0.001	359.5	0.002	154.8	0.001	33.4	0	144.5	0
D-PHENOTHRIN	Insect	197	0.001	50.8	0.0	14.8	0	6.8	0		
COPPER SULPHATE	Fung	183	0.001	422.0	0.003	23.7	0	672.1	0.01	316.1	0
FLONICAMID	Insect	180	0.001	24.1	0.0						
FISH MEAL MIXTURE	Vert	173	0.001	12.5	0.0						
ALUMINUM PHOSPHIDE	Insect	155	0.001	79.9	0.0	569.3	0.005	269.6	0	2 215.7	0.02
ETHAMETSULFURON-METHYL	Herb	138	0.001	77.1	0.0	238.0	0.002	844.4	0.01	4 636.4	0.05
DIAZINON	Insect	135	0.001	986.6	0.006	2 541.5	0.02	5 149.9	0.06	4 087.3	0.04
CYFLUTHRIN	Insect	132	0.001	89.0	0.0	351.6	0.003	92.3	0	1.3	0
FOSETYL-AL	Fung	123	0.001	89.1	0.0	466.5	0.004	351.8	0	166.3	0
SILOXYLATED POLYETHER	Adj	103	0.001	662.7	0.004	1 690.2	0.01	1 130.9	0.01		
N-ALKYL DIMETHYL ETHYLBENZYL AMMONIUM CHLORIDE	A-M	103	0.001								
MESOTRINE	Fung	94	0.001								
BUTOXYPOLYPROPYLENE GLYCOL	Insect	93	0.001	110.1	0.0	4 161.6	0.03	370.2	0	2.3	0
BACILLUS SUBTILUS (QT713)	Fung	93	0.001	680.6	0.004	17.7	0				
BACILLUS SUBTILIS (MB1600)	Insect	89	0.001	189.7	0.001						
TRINEXAPAC-ETHYL	PGR	86	0.001	112.2	0.0	77.7	0.001	44.8	0		
TEFLUTHRIN	Insect	83	0.0	0.6	0.0						
FERRIC SODIUM EDTA	Insect	68	0.0	82.9	0.0	28.1	0				
NICOSULFURON	Herb	68	0.0	27.9	0.0	126.7	0.001	140.1	0		
METHYLATED CANOLA OIL	Adj	67	0.0	134 649.3	0.9	187 385.6	1.5				
COPPER OXYCHLORIDE	Fung	65	0.0	3.0	0.0	144.7	0.001	649.5	0.01	220.2	0
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	Fung	61	0.0	19.1	0.0						
PYMETROZINE	Insect	58	0.0	50.4	0.0	55.5	0	95.0	0		
DIMETHENAMID-P	Herb	58	0.0								
DIDECYL DIMETHYL AMMONIUM CHLORIDE	A-M	57	0.0	73.5	0.0	106.5	0.001	167.4	0	120.6	0

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BACILLUS AMYLOLIQUEFACIENS, STRAIN D747	Fung	56	0.0								
D-CIS, TRANS ALLETHRIN	Insect	55	0.0	23.3	0.0	15.1	0	5.7	0	1.7	0
ACEPHATE	Insect	51	0.0	76.5	0.0	376.9	0.003	383.6	0	257.6	0
P-MENTHANE-3, 8-DIOL	Insect	49	0.0	39.5	0.0	1.3	0	22.7	0		
PENTHIOPYRAD	Fung	49	0.0	13 179.3	0.09						
DAMINOZIDE	PGR	46	0.0	54.8	0.0	57.8	0	119.9	0	147.5	0
DESMEDIPHAM	Herb	46	0.0	12.2	0.0	645.2	0.005	1 348.5	0.01	2 334.8	0.03
PHENMEDIPHAM	Herb	46	0.0	12.2	0.0	434.1	0.003	1 348.5	0.01	2 330.3	0.03
DRIED WHOLE EGGS	Vert	45	0.0	3.6	0.0						
METHOMYL	Insect	45	0.0	8.1	0.0	54.8	0	436.8	0	434.5	0
SPIROMESIFEN	Insect	44	0.0	458.4	0.003	1.7	0				
ASPHALT SOLIDS	Fung	40	0.0	429.6	0.003	614.7	0.005	591.9	0.01	1 387.5	0.01
QUINCLORAC	Herb	37	0.0	1 509.3	0.01	213.2	0.002	878.1	0.01	1 459.4	0.02
SODIUM CHLORIDE	Herb	33	0.0								
SURFACTANT MIXTURE	Adj	33	0.0	209.3	0.001	533.8	0.004				
D-TRANS ALLETHRIN	Insect	32	0.0	72.2	0.0	25.2	0	320.6	0	20.7	0
OIL OF BLACK PEPPER	Vert	30	0.0	13.6	0.0	27.7	0	16.5	0	12.0	0
BACILLUS THURINGIENSIS SSP KURSTAKI	Insect	29	0.0	30.2	0.0	184.5	0.001	35.8	0	775.2	0.01
HALOSULFURON	Herb	27	0.0								
CAPTAN	Fung	26	0.0	64.8	0.0	429.8	0.003	439.4	0	286.8	0
DISODIUM OCTABORATE TETRAHYDRATE	Wood	26	0.0								
GARLIC OIL	Insect/ Vert	25	0.0	4.8	0.0						
CYMOXANIL	Fung	23	0.0	1 041.6	0.007			65.9	0		
CYAZOFAMID	Herb	23	0.0	161.2	0.001						
THYMOL	Insect	22	0.0								
AMETOCTRADIN	Fung	21	0.0								
WINTERGREEN OIL	Vert	21	0.0	1.4	0.0						

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STREPTOMYCIN	Fung	21	0.0	1.3	0.0			1.0	0	2.1	0
BETA-CYFLUTHRIN	Insect	20	0.0								
AZADIRACHTIN	Insect	19	0.0								
BEAUVERIA BASSIANA STRAIN GHA	Insect	19	0.0	3.7	0.0						
MYCLOBUTANIL	Fung	19	0.0	31.6	0.0	16.7	0	162.6	0	16.8	0
POLY[OXYETHYLENE(DIMETHYLIMINIO)ETHYLENE(DIMETHYLIMINIO)ETHYLENE DICHLORIDE]	A-M	19	0.0								
ACETAMIPRID	Insect	17	0.0	53.3	0.0	414.6	0.003				
FERRIC PHOSPHATE	Insect	17	0.0	23.1	0.0	28.8	0	11.3	0		
CYPERMETHRIN	Insect	17	0.0	8.3	0.0	30.9	0	26.1	0	439.6	0
CUPROUS OXIDE (COPPER AS ELEMENTAL)	A-M	16	0.0	25.4	0.0						
DIMETHOMORPH	Fung	16	0.0	0.9	0.0	1.8	0	9.9	0	72.9	0
MEAT MEAL MIXTURE	Vert	16	0.0	1.4	0.0						
SPINOSAD FACTOR A PLUS	Insect	15	0.0	25.4	0.0	18.7	0	1.9	0		
METHYL NONYL KETONE	Vert	14	0.0	3.0	0.0	24.1	0	27.5	0	50.0	0
SODIUM HYPOCHLORITE	Fung	12	0.0	243.5	0.002						
BEAUVARIA BASSIANA STRAIN ANT 03	Insect	12	0.0								
OXATHIAPIPROLIN	Fung	12	0.0								
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	Fung	12	0.0	3.4	0.0						
TRIFLUSULFURON METHYL	Herb	12	0.0	4.4	0.0	75.1	0.001	81.8	0		
BIFENAZATE	Insect	11	0.0	25.9	0.0	12.6	0				
DI-N-PROPYL ISOCINCHOMERONATE	Insect	11	0.0	9.8	0.0	144.9	0.001	5.8	0	6.4	0
GLIOCLADIUM CATENULATUM	Fung	11	0.0	0.2	0.0	3.6	0				
ACEQUINOCYL	Insect	10	0	8.2	0.0	3.5	0				
SPINETORAM	Insect	10	0.0								
OXADIAZON	Herb	10	0.0	11.8	0.0	27.2	0	19.9	0	41.2	0
PERACETIC ACID	A-M	10	0.0								

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TETRACHLORVINPHOS	Insect	10	0							52.0	0
FISH OIL MIXTURE	Vert	9	0.0	0.6	0.0						
BUPROFEZIN	Insect	9	0.0								
CASTOR OIL	Vert	8	0.0	0.6	0.0						
FATTY ACID	Herb	8	0.0			36.9	0	88.9	0	34.6	0
FLUOPICOLIDE	Insect	8	0.0	112.1	0.0						
METOFLUTHRIN	Insect	8	0.0	1.4	0.0						
METALDEHYDE	Insect	7	0.0	48.9	0.0	105.5	0.001	101.3	0	476.5	0.01
POLYMERIZED BUTENES	Vert	7	0.0	31.9	0.0			21.7	0	92.9	0
DICHLORPROP	Herb	6	0.0	7 848.8	0.05	52 271.6	0.4	57 450.1	0.62	40 942.4	0.4
ETRIDIAZOLE	Herb	6	0.0	16.8	0.0	54.9	0	122.1	0	210.6	0
1-OCTEN-3-OL	Insect	6	0.0	1.4	0.0	1.6	0				
ISOFETAMID	Fung	6	0.0								
COPPER (PRESENT AS COPPER OCTANOATE)	Fung	6	0.0								
DENATONIUM BENZOATE	Vert	6	0.0			0.5	0				
FENBUTATIN OXIDE	Insect	5	0.0	12.0	0.0	8.6	0	22.1	0	12.4	0
PARAQUAT	Herb	5	0.0	1 649.6	0.01	1 727.6	0.01	1 591.6	0.02	4 820.4	0.05
PROHEXADIONE CALCIUM	PGR	5	0.0								
METHYL ANTHRANILATE	Vert	5	0.0					4.1	0		
ANCYMIDOL	PGR	4	0.0	0.001	0.0	0.03	0	0.03	0	0.1	0
CHLORPROPHAM	PGR	4	0.0								
EXTRACT OF *REYNOUTRIA SACHALINENSIS*	Fung	4	0.0	24.0	0.0						
FLUPYRADIFURONE	Insect	4	0.0								
FLUVALINATE	Insect	4	0.0								
PYRIDABEN	Insect	4	0.0	5.5	0.0	350.6	0.003	23.5	0	17.1	0
Z-9-TRICOSENE	Insect	4	0.0	1.0	0.0	1 097.3	0.009	0.2	0	0.6	0
PIPERINE	Vert	3	0.0	1.5	0.0	1.0	0	0.6	0	0.4	0
TEPRALOXYDIM	Herb	3	0.0	5 885.9	0.04	4 881.3	0.04				

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
SPIRODICLOFEN	Insect	3	0.0								
CAPSAICIN	Vert	2	0.0	0.2	0.0	0.2	0	0.1	0	0.1	0
CYFLUMETOFEN	Insect	2	0.0								
CHLORFENAPYR	Insect	2	0.0								
S-METHOPRENE	Insect	2	0.0								
POLYOXIN D ZINC SALT	Fung	2	0.0								
MANDESTROBIN	Fung	2	0.0								
ABAMECTIN	Insect	2	0.0	2.6	0.0	2.9	0	6.7	0	3.6	0
BROMADIOLONE	Vert	2	0.0	0.8	0.0	5.9	0	1.2	0	1.2	0
CHLOROPHACINONE	Vert	2	0.0	0.4	0.0	23.7	0	1.7	0	1.8	0
CYROMAZINE	Insect	2	0.0	4.1	0.0	2.7	0	9.8	0		
FENHEXAMID	Fung	2	0.0	12.0	0.0	14.3	0	2.5	0		
GARLIC POWDER	Fung	2	0.0	10.0	0.0						
BACILLUS SPHAERICUS	Insect	1	0.0			152.4	0.001				
FLUAZIFOP-P-BUTYL	Herb	1	0.0	6.0	0.0	1 830.8	0.01	5 808.5	0.06	12 914.0	0.1
FENAMIDONE	Fung	1	0.0	298.2	0.002	5.0	0				
LACTIC ACID	Fung	1	0.0	3.0	0.0						
PACLOBUTRAZOL	PGR	1	0.0	0.5	0.0	3.0	0	0.2	0		
TEA TREE OIL	Fung	1	0.0								
WARFARIN	Vert	1	0.0	1.0	0.0	3.8	0	2.0	0	1.8	0
FENPYROXIMATE	Insect	0.8	0.0								
CITRIC ACID	A-M	0.7	0.0	1.5	0.0						
BROMETHALIN	Vert	0.5	0.0	0.06	0.0	0.2	0				
DIPHACINONE	Vert	0.5	0.0	1.7	0.0	0.9	0	0.4	0	0.4	0
S-KINOPRENE	Insect	0.5	0.0								
HYDRAMETHYLNON	Insect	0.5	0.0	0.7	0.0	0.9	0	20.4	0	9.2	0
PYRIPROXYFEN	Insect	0.5	0.0	0.5	0.0	0.9	0				
GIBBERELLIC ACID	PGR	0.4	0.0	0.03	0.0	0.004	0	0.06	0	0.6	0
PRALLETHRIN	Insect	0.4	0.0								

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
BRODIFACOUM	Vert	0.3	0.0	0.3	0.0	2.3	0	0.08	0	0.1	0
6-BENZYLAMINOPURINE	PGR	0.2	0.0	0.03	0.0			0.04	0		
STREPTOMYCES LYDICUS	Fung	0.2	0.0	2.2	0.0	0.02	0				
STREPTOMYCES LYDICUS	Fung	0.2	0.0								
4-AMINOPYRIDINE	Vert	0.2	0.0	0.03	0.0	0.4	0	0.2	0	1.5	0
METARHIZIUM ANISOPLIAE (STRAIN F52)	Insect	0.1	0.0	0.1	0.0						
PROPOXUR	Insect	0.09	0.0	48.1	0.0	41.3	0	107.2	0	170.0	0
FOLPET	Insect	0.08	0.0	33.8	0.0	35.9	0	55.4	0	54.8	0
TRICHODERMA ASPERELLUM, STRAIN T34	Fung	0.07	0.0								
DIFETHIALONE	Vert	0.06	0.0	0.04	0.0	0.2	0	0.06	0		
NOVALURON	Insect	0.02	0.0								
UNICONAZOLE-P	PGR	0.02	0.0	0.02	0.0	0.02	0				
4-CPA	PGR	0.02	0.0	0.01	0.0	0.03	0			0.0015	0
STREPTOMYCES GRISEOVIRIDIS	Fung	0.01	0.0	0.03	0.0	0.008	0	0.04	0		
ALLETHRIN	Insect	0.004	0.0								
DIFENZOQUAT	Herb			4 580.6	0.03	3 792.0	0.03	4 464.0	0.05	9 585.5	0.1
FOMESAFEN	Herb			2 586.4	0.02						
NAPHTHALENE	Insect			2 449.3	0.02	2 318.2	0.02	118.5	0	1 371.6	0.01
LIQUID CORN GLUTEN	Herb			2 246.8	0.01						
DIFLUFENZOPYR	Herb			1 178.7	0.008						
SAFER'S INSECTICIDAL SOAP	Insect			479.8	0.003	902.0	0.007	1 040.2	0.01	1 941.6	0.02
ENDOSULFAN	Insect			328.0	0.002	294.9	0.002	5 229.7	0.05	761.1	0.01
OXYFLUORFEN	Herb			69.0	0.0	89.0	0.001	46.0	0	27.4	0
OXAMYL	Insect			48.0	0.0	2.4	0	2.4	0	9.6	0
NATURAL GUM RESINS	Insect			41.9	0.0	32.3	0	0.7	0	9.0	0
ZOXAMIDE	Fung			31.6	0.0						
ZINEB	Fung			31.2	0.0	51.5	0	99.5	0	491.7	0.01
MANEB	Fung			17.4	0.0	1 521.5	0.01	3 346.4	0.04	8 462.0	0.09

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
ROTENONE	Herb			11.1	0.0	49.7	0	61.7	0	180.0	0
TEBUFENOZIDE	Insect			9.1	0.0	15.4	0	8.6	0		
PROPETAMPHOS	Insect			6.5	0.0	18.9	0	0.3	0		
FAMOXADONE	Fung			5.1	0.0						
COAL TAR OILS	A-M			4.3	0.0					1.2	0
PUTRESCENT WHOLE EGG SOLIDS	Vert			3.8	0.0	11.3	0			7.4	0
PAECILOMYCES FUMOSOROSEUS STRAIN FE 9901	Insect			3.4	0.0						
FERBAM	Herb			2.8	0.0	80.1	0.001	95.1	0	77.6	0
RESMETHRIN	Insect			2.3	0.0	134.0	0.001	17.5	0	2.4	0
DODEMORPH-ACETATE	Fung			2.0	0.0	3.6	0	42.8	0	55.2	0
KINOPRENE	Insect			1.6	0.0	2.5	0	9.9	0	33.6	0
COAL TAR ACIDS	A-M			1.3	0.0					0.3	0
TRIASULFURON	Herb			0.8	0.0	45.5	0	190.3	0	505.0	0.01
PHOSALONE	Insect			0.7	0.0	21.4	0	23.5	0	5.6	0
DIFLUBENZURON	Insect			0.4	0.0	2.3	0	2.6	0		
SCLEROTINIA MINOR IMI 3144141	Herb			0.4	0.0						
BRONOPOL	A-M			0.3	0.0	276.4	0.002	192.1	0		
CLOFENTEZINE	Insect			0.2	0.0						
METHOPRENE	Insect			0.2	0.0	174.1	0.001	6.7	0		
SULFAQUINOXALINE	Vert			0.1	0.0	0.4	0	0.4	0	1.4	0
QUINTOZENE	Fung					7 528.8	0.06	7 166.5	0.08	9 808.9	0.1
METHYL BROMIDE	Insect					6 106.3	0.05			1 850.9	0.02
VINCLOZOLIN	Fung					4 995.0	0.04	24 324.3	0.26	25 823.1	0.3
SIMAZINE	Herb					4 725.1	0.04	1 160.4	0.01	3 688.1	0.04
MECOPROP-D	Herb					3 271.0	0.03	26 080.4	0.28	27 264.1	0.3
TERBUFOS	Insect					1 797.0	0.01	2 893.0	0.03	6 697.8	0.07
SULPHUR (INSECTICIDE)	Insect					1 314.0	0.01	96.6	0	280.7	0
FORMALDEHYDE	Fung					464.0	0.004	17.8	0	96.2	0

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
DAZOMET	Soil fumigant					392.0	0.003	78.4	0	627.2	0.01
SODIUM ALPHA-OLEFIN SULFONATE	Adj					291.0	0.002	299.1	0		
CARBOFURAN	Insect					265.0	0.002	676.1	0.01	6 413.4	0.07
METHAMIDOPHOS	Insect					230.4	0.002	1 008.0	0.01	19.2	0
OXYCARBOXIN	Fung					216.5	0.002	185.3	0	154.1	0
SOAP (HERBICIDAL)	Herb					188.4	0.002	42.4	0	10.4	0
AZINPHOS-METHYL	Insect					69.2	0.001	304.0	0	260.6	0
NICOTINE	Insect					36.4	0	27.2	0	27.5	0
WATER SOLUBLE DYES	Herb					35.1	0	48.7	0	5.1	0
PROPANIL	Herb					32.0	0	96.0	0	1616.0	0.02
DICOFOL	Insect					27.0	0	84.0	0	423.6	0
ZINC PHOSPHIDE	Vert					26.3	0	435.3	0	49.2	0
CHLORPROPHAM	Herb					20.2	0	120.4	0	679.8	0.01
OXINE BENZOATE	Fung					17.0	0	52.5	0	59.1	0
MESOTRIONE	Fung					9.2	0				
DICLOFOP-METHYL	Herb					5.7	0	715.2	0.01	3 239.9	0.03
PHOSMET	Insect					5.6	0	140.7	0	370.0	0
SULFOSULFURON	Herb					5.2	0	596.3	0.01		
AMMONIA	Vert					2.3	0	0.4	0	1.1	0
ISOXABEN	Herb					1.4	0				
FENTHION	Insect					0.8	0	418.8	0	293.6	0
QUIZALOFOP-ETHYL	Herb					0.8	0	44.7	0	23 101.0	0.2
ARTIFICIAL ESSENTIAL OIL BLEND	Insect					0.4	0			2.1	0
SPINETORAM	Insect					0.2	0				
BENDIOCARB	Insect					0.2	0	36.0	0	59.3	0
D-CIS ALLETHRIN	Insect					0.03	0				
GERMAN COCKROACH EXTRACT	Insect					0.006	0				
CHOLECALCIFEROL	Vert					0.003	0	0.01	0	0.1	0

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
AMMONIUM SULPHATE	Adj							51 595.1	0.56	71 104.4	0.8
LINDANE	Insect							4 779.5	0.05	56 743.7	0.6
BENOMYL	Fung							3 275.0	0.04	14 616.3	0.2
TRICHLORFON	Insect							2 331.3	0.03	34 334.3	0.4
CYCLOATE	Herb							460.8	0	2 289.6	0.02
METAM	Soil fumigant							415.1	0	410.7	0
CHLORONEB	Fung							233.9	0	559.3	0.01
TALL OIL FATTY ACIDS	Adj							176.0	0	1 470.4	0.02
PIRIMICARB	Insect							162.2	0	154.1	0
TRIADIMENOL	Fung							120.1	0	178.0	0
SODIUM METABORATE TETRAHYDRATE	Herb							117.5	0	1 616.3	0.02
BENSULIDE	Herb							95.9	0	212.6	0
PARAFORMALDEHYDE	A-M							68.3	0		
OCTYLPHENOXYPOLYETHOXYETHANOL PHOSPHATE ESTER	Adj							60.5	0		
CREOSOTE	A-M							58.1	0	805.2	0.01
SODIUM CHLORATE	Herb							53.0	0	729.1	0.01
CYANAZINE	Herb							45.0	0	3 891.6	0.04
ENDOTHALL	Herb							44.3	0	511.0	0.01
N-ALKYL POLYETHOXYETHANOL	Adj							32.5	0	52.5	0
METHOXYCHLOR	Insect							24.7	0	109.9	0
1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN	A-M							22.4	0	20.5	0
TRIFORINE	Fung							22.0	0	20.6	0
N-ALKYL DIETHANOLAMINE	Adj							20.8	0	33.6	0
1,2-ETHANEDIOL	Adj							17.4	0	87.0	0
PYRIDATE	Herb							12.6	0	486.0	0.01

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
METHIOCARB	Insect							12.1	0		
METOLACHLOR	Herb							11.2	0	4 297.9	0.05
COUMAPHOS	Insect							7.3	0	45.6	0
10,10'-OXYBIS(PHENOXARSINE)	A-M							5.3	0		
ETHION	Insect							4.6	0	32.1	0
FENVALERATE	Fung							3.8	0	4.1	0
ALLETHRIN	Insect							2.8	0	2.0	0
FLAMPROP-M-METHYL	Herb							0.08	0	1 091.5	0.01
DITHIOPYR	Herb							0.05	0	2.1	0
FENOXAPROP-ETHYL	Herb							0.012	0	117.9	0
ERGOCALCIFEROL	Vert							0.002	0	0.02	0
DISODIUM OCTABORATE TETRAHYDRATE	A-M									1 033.5	0.01
VEGETABLE OIL	Adj									874.0	0.01
METHIDATHION	Insect									580.8	0.01
OXYDEMETON-METHYL	Insect									469.5	0.01
FONOFOS	Insect									330.0	0
COPPER TRIETHANOLAMINE COMPLEX	A-M									145.2	0
SULFOTEP	Insect									128.1	0
CHLORINE DIOXIDE FROM SODIUM CHLORITE	A-M									54.0	0
DIENOCHLOR	Insect									48.8	0
PARATHION	Insect									23.9	0
COPPER 8-QUINOLINOLATE	A-M									13.6	0
DODINE	Fung									13.0	0
CHLORTHAL	Herb									13.0	0
FLUAZIFOP-BUTYL	Herb									12.0	0
AMMONIUM SULPHAMATE	Herb									10.4	0
CHINOMETHIONAT	Insect									6.5	0

ACTIVE INGREDIENT NAME	Type of use	2018 total (kg ai)	2018 %	2013 total (kg ai)	2013 %	2008 total (kg ai)	2008 %	2003 total (kg ai)	2003 %	1998 total (kg ai)	1998 %
NAPTALAM	Herb									4.8	0
ARTIFICIAL ESSENTIAL OIL BLEND	Insect									4.5	0
ARSENIC (MSMA)	Herb									3.8	0
TEBUTHIURON	Herb									3.2	0
CHLORAMBEN	Herb									1.4	0
ANILAZINE	Fung									1.0	0
SODIUM FLUOSILICATE	Insect									1.0	0
DICHLONE	Fung									0.4	0
O-PHENYLPHENOL	A-M									0.2	0
TRIBUTYLTIN OXIDE	A-M									0.1	0
TOTAL		**16 744 639**	**100**	**15 231 072**	**100**	**12 476 096**	**100**	**9 264 488**	**100**	**9 273 494**	**100**

A-M – Anti-microbial
Adj – Adjuvant, Surfanct
Fung – Fungicide
Herb – Herbicide
Insect – Insecticide, Repellent, Insect Growth Regulator
PGR – Plant Growth Regulator
Vert – Vertebrate Repellent, Rodenticide
Wood – Wood Preservative

Appendix 3. 2018 Pesticide Sales by Active Ingredient (kg ai) and River Basin

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN		169.2	93.1	50.8	101.5		67.7	33.8		67.7	25.4		609.1
1-OCTEN-3-OL		0.8	0.7	0.4	0.5	0.01	2.2	0.3	0.7	0.5	0.02	0.1	6.4
2,4-D	7764.0	12302.8	57805.5	3386.4	62909.6	18273.1	79028.1	259588.0	29285.1	94559.3	22342.7	72728.3	719973.4
2,4-DB		162.5	718.8		106.3		156.3	2126.5	402.0	1917.3		162.5	5752.0
3-DECEN-2-ONE								815.0					815.0
4-AMINOPYRIDINE	0.1		0.01										0.1
4-CHLOROINDOLE-3-ACETIC ACID	124.9	4.9	3.7	1.0	38.1	0.03	35.6	7.1	4.3	10.0	0.2	1.4	231.2
4-CPA	0.003	0.002	0.001	0.001	0.001	0.0001	0.003	0.001	0.002	0.002		0.00004	0.02
6-BENZYLAMINOPURINE	0.2												0.2
ABAMECTIN	0.9	0.01	0.01	0.002	0.9	0.0002	0.03	0.01	0.004	0.01	0.0002	0.003	1.8
ACEPHATE	6.8				29.3			14.6					50.6
ACEQUINOCYL	7.9				1.7								9.6
ACETAMIPRID	4.5		3.8		2.6		1.9	3.8					16.6
ACETIC ACID	40.0	120.5	44.5	22.8	650.6	0.5	789.5	157.1	96.1	145.4	160.0	46.4	2273.3
ACROLEIN					2257.4			28207.6		7718.8		15918.4	54102.3
ALCOHOLS, C9-11, ETHOXYLATED			82.8	110.4			404.8		64.4	432.4	128.8		1223.6
ALLETHRIN					0.001			0.003					0.004
ALUMINUM PHOSPHIDE								142.8				12.0	154.8
AMETOCTRADIN								16.1		5.0			21.1
AMINOCYCLOPYRACHLOR	2012.7	72.9	30.7		65.1		76.4	12.4	4.1	20.6		5.4	2300.4
AMINOPYRALID	330.8	782.4	1115.9	92.0	589.5		2607.4	853.7	2040.0	1201.6	140.7	16.5	9770.3
AMITRAZ							277.6						277.6
AMITROLE					32.3		25.4	106.3	1064.9	101.6			1330.6
AMMONIUM SOAP OF FATTY ACID	234.3	24.8	15.4	2.6	151.2		107.3	24.4	17.3	31.8	0.3	8.8	618.1
ANCYMIDOL	4.0				0.001								4.0
ASPHALT SOLIDS		3.0	2.9	0.9	7.1		16.7	2.1	1.8	4.6		0.9	40.0

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
ATRAZINE		9.0	2508.9		780.2		663.0	11477.5	75.8	1604.7	1028.3	1050.8	19198.2
AZADIRACHTIN	18.5												18.5
AZOXYSTROBIN	2.6	1059.1	4503.2	268.1	2730.0		6006.3	11263.0	4260.8	27339.1	36.6	1425.7	58894.6
BACILLUS AMYLOLIQUEFACIENS, STRAIN D747					56.1								56.1
BACILLUS FIRMUS I-1582		0.3	129.8	0.5	120.8		109.6	833.4		181.4	85.2	360.1	1821.2
BACILLUS SPHAERICUS					1.4								1.4
BACILLUS SUBTILIS (MB1600)		0.2	0.03				2.2	9.6	53.1	24.0			89.2
BACILLUS SUBTILIS (QT713)	6.1		60.4		14.5		11.7						92.7
BACILLUS THURINGIENSIS BERLINER SSP KURSTAKI	2.1	0.4	0.5	2.5	5.5	0.002	3.5	12.8	0.2	0.7	0.01	0.4	28.6
BACILLUS THURINGIENSIS, SEROTYPE H-14	0.7	3.8	3.1	0.4	1021.6		11.0	1.0	3.7	1.7	0.01	0.4	1047.4
BEAUVARIA BASSIANA STRAIN ANT 03					12.3								12.3
BEAUVERIA BASSIANA STRAIN GHA	15.0				3.7								18.8
BENTAZON (PRESENT AS SODIUM SALT)		7524.6	29961.0	736.7	16229.9	1191.9	29142.9	67274.1	49227.4	31871.3	6946.3	24659.2	264765.4
BENZOVINDIFLUPYR	11.3	570.6	2932.0	63.8	4145.3		2081.3	21184.3	4648.9	3858.8	51.0	3665.4	43212.9
BETA-CYFLUTHRIN	3.8				2.3		12.6	0.2		1.0		0.7	20.5
BIFENAZATE	6.4				4.7			0.2					11.4
BIFENTHRIN								902.3					902.3
BISPYRIBAC-SODIUM			1337.6		0.2		3.5		0.2				1341.4
BORACIC ACID	0.0	10.7	11.2		1442.1		16.7		12.3	23.1			1516.1
BORAX	70.5	20.0	16.4	5.6	81.7	0.5	67.3	23.9	16.4	28.6	0.6	9.8	341.3
BOSCALID	4.3	2663.6	6169.5	392.2	2746.1		5171.1	7775.6	7368.5	3054.9	855.0	2305.3	38506.0
BRODIFACOUM	0.0004	0.02	0.03	0.0002	0.04		0.1	0.04	0.02	0.1	0.01	0.01	0.3
BROMACIL		12.0	54.3	9.9	22.7	0.6	69.0	55.7	27.8	54.5	3.9	18.3	328.5
BROMADIOLONE	0.2	0.1	0.1		0.3		0.5	0.1	0.1	0.2	0.1	0.1	1.7
BROMETHALIN		0.04	0.05	0.002	0.09	0.0001	0.2	0.04	0.04	0.04	0.002	0.01	0.5
BROMOXYNIL	328.2	9135.8	46209.1	7306.8	30534.8	2366.4	55720.4	90111.7	39000.7	55400.7	11292.0	20321.5	367727.9
BUPROFEZIN	4.9				3.9								8.8
BUTOXYPOLYPROPYLENE GLYCOL		9.5	6.1	8.3	7.8		34.4	4.7	12.7	5.3		3.8	92.5
CALCIUM HYPOCHLORITE		216.7	328.8	64.0	29.9		62.8	57.4	468.6	35.2			1263.4
CALCIUM POLYSULPHIDE	33.1	9.2	11.3	1.6	110.4		128.6	11.0	19.1	19.3		7.4	351.0
CANOLA OIL					57.6			9.6					67.2

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
CAPSAICIN (OLEORESIN CAPSICUM)	0.003	0.4	0.08	0.01	0.1	0.002	0.1	0.3	0.4	0.2	0.0003	0.02	1.5
CAPTAN	8.0		0.2	0.1	16.2	0.1	0.4	1.1		0.4			26.5
CARBARYL	1014.4	33.8	106.3	1.5	209.3	0.9	180.9	260.5	75.8	244.6	19.2	78.0	2225.2
CARBATHIIN		65.1	1965.9	38.6	934.5	69.3	3549.2	2072.7	1382.0	839.7	427.6	310.1	11654.8
CARFENTRAZONE-ETHYL	79.8	421.3	1084.1	46.8	405.0	41.4	1290.5	2388.4	523.8	1038.3	232.9	749.4	8301.9
CASTOR OIL		0.5	0.8	0.1	2.5	0.02	0.9	0.8	0.4	0.9	0.02	0.6	7.6
CELLULOSE (FROM POWDERED CORN COBS)	922.0	623.0	426.8	137.7	3177.6	24.4	2292.4	387.0	521.1	515.4	3.7	102.6	9133.6
CHLORANTRANILIPROLE	5.3	15.6	31.2		25.0	6.0	50.6	882.1	66.0	142.7	7.2	277.3	1509.1
CHLORFENAPYR	1.6				0.7								2.3
CHLORMEQUAT	12.9	1630.6	7018.4		6997.3		11005.0	15351.2	2672.2	4237.7		7390.4	56315.7
CHLOROPHACINONE	1.3	0.02	0.02	0.01	0.1	0.01	0.1	0.02	0.02	0.1	0.001	0.2	1.9
CHLOROTHALONIL	15512.5	6.8	196.5		11289.8		4866.5	54597.6	47.7	856.5		914.2	88288.2
CHLORPROPHAM	2.8				1.4								4.2
CHLORPYRIFOS		99.7	396.8		627.2		197.6	3321.6	5514.3	1499.0	124.8	1488.0	13269.1
CHLORSULFURON	171.9	32.9	7.2		5.4		12.9		5.4	1.7		2.2	239.7
CITRIC ACID	0.6	0.01			0.1								0.7
CLETHODIM		1313.3	7567.1	169.9	2571.1	210.2	8227.4	7440.6	5443.2	4266.0	1068.5	1913.0	40190.4
CLODINAFOP-PROPARGYL	63.6	296.6	1447.1	4.1	597.4	848.1	2418.9	8694.5	2228.9	4388.6	1134.7	3216.7	25339.3
CLOMAZONE		287.7	6815.7	29.2	874.2		5188.5	147.7	285.8	3417.6	77.8	19.4	17143.6
CLOPYRALID	195.4	2086.8	14341.3	107.9	3809.8	111.6	17884.7	12851.5	12960.0	8873.4	1308.8	1859.2	76390.3
CLOTHIANIDIN	0.9	1398.1	9911.3	161.8	2866.1	124.0	8436.8	19720.6	10428.5	6777.7	435.2	1124.1	61385.1
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08							5.3			8.5		47.7	61.5
COPPER (CUPRIC) HYDROXIDE			5.0		322.1			1160.6		15.0		2595.0	4097.7
COPPER (PRESENT AS COPPER OCTANOATE)	1.6	0.002		0.001	0.03		0.02	4.5	0.004	0.003			6.2
COPPER NAPHTHENATE		120.7	42.5	16.0	51.6	2.3	140.7	34.2	76.1	39.7	0.1	25.5	549.4
COPPER OXYCHLORIDE					63.0		2.0						65.0
COPPER SULPHATE	6.1		0.8	1.0	11.4			150.3	0.2	0.3	0.4	12.2	182.8
COPPER SULPHATE TRIBASIC	77.6	10.5	9.9	4.6	48.4	1.5	48.1	30.7	23.3	25.0	0.3	5.1	285.0
CORN GLUTEN MEAL	16934.4	20654.6	7269.5	6410.4	65144.9	559.9	65324.8	15016.4	11036.8	18363.9	60.9	6592.9	233369.4
CUPROUS OXIDE (COPPER AS ELEMENTAL)		3.8		5.8	1.0		3.0		1.5	0.5			15.5
CYANTRANILIPROLE	1.1	511.3	4860.5	4.0	884.8	10.9	3084.8	1126.9	9873.8	1928.5	214.2	574.3	23075.0

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
CYAZOFAMID	22.8							0.3					23.1
CYFLUMETOFEN								2.4					2.4
CYFLUTHRIN	9.2	4.6	33.5	0.1	7.1		29.3	12.2	3.3	21.5	4.2	6.8	131.7
CYHALOTHRIN-LAMBDA	78.3	83.5	109.5	11.3	276.9	25.3	388.1	1453.2	877.6	391.9	12.7	163.6	3871.9
CYMOXANIL								22.7					22.7
CYPERMETHRIN	0.1		0.5		0.2		5.8	9.3		0.4		0.9	17.1
CYPRODINIL	22.4		9.2		12.1		2.4	208.6		69.8			324.5
CYROMAZINE	2.0												2.0
DAMINOZIDE	17.9				28.5								46.3
D-CIS, TRANS ALLETHRIN		7.6	4.5	2.3	6.3	0.01	23.1	1.3	6.5	2.9	0.04	0.7	55.3
DEET	1.6	1009.7	863.1	388.9	1596.3	19.6	3560.4	312.4	1182.3	675.2	11.9	199.2	9820.4
DELTAMETHRIN	0.5	91.7	104.2	2.8	81.1	1.1	239.7	401.6	146.8	253.1	11.5	54.6	1388.7
DENATONIUM BENZOATE		0.2	0.2	0.1	2.7		1.5	0.3	0.2	0.5		0.2	6.0
DESMEDIPHAM					9.2			4.6		32.1			45.9
DIAZINON	0.1	20.0	4.0		0.7		17.7	60.8		28.6		3.1	134.9
DICAMBA	689.0	500.9	1350.8	99.9	3212.9	855.3	2351.7	24324.8	2034.3	8038.2	411.1	10141.4	54010.4
DICHLOBENIL	89.9	17.3	103.2		118.0		129.2	145.3	9.1	42.7		77.0	731.5
DICHLORPROP						6.4							6.4
DICHLORPROP-P					16.3	30.6	14.3	644.6	2.0	689.5	24.5	14.7	990.0
DICHLORVOS	6.0	21.3	25.2	5.4	41.2	0.7	54.4	50.9	17.6	36.0	0.5	4.3	263.5
DIDECYL DIMETHYL AMMONIUM CHLORIDE	56.7												56.7
DIFENOCONAZOLE		555.3	2100.8	34.1	1595.9	73.4	18123.4	8074.6	2050.4	2194.9	105.7	1362.9	36271.4
DIFETHIALONE	0.005	0.01	0.01		0.002		0.03	0.003	0.003	0.004		0.004	0.1
DIFLUFENZOPYR-SODIUM	35.9	43.5	0.9		23.0		23.1	613.3	42.3	115.0	30.6	420.1	1347.8
DIMETHENAMID-P								58.3					58.3
DIMETHOATE	9.6	4.8	52.8		590.4		129.6	249.1	14.4	417.6		72.0	1540.3
DIMETHOMORPH								12.1		3.7			15.8
DI-N-PROPYL ISOCINCHOMERONATE		0.9	0.8	0.5	1.2	0.1	5.2	0.6	1.2	0.7	0.01	0.3	11.5
DIPHACINONE	0.1	0.03	0.03	0.01	0.1	0.02	0.1	0.02	0.02	0.04	0.001	0.01	0.4
DIQUAT	691.2	2820.8	8982.1	273.2	12275.0	419.6	12581.4	79910.1	17397.3	18796.4	1834.4	17792.6	173774.1
DISODIUM OCTABORATE TETRAHYDRATE	0.005	0.6	1.8	0.4	7.8		10.7	1.7	0.6	1.2	0.1	0.9	25.9

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
DIURON	960.0		48.0		8.0		912.0	16.0		56.0		96.0	2096.0
D-PHENOTHRIN	31.9	10.1	9.9	2.9	47.6	0.5	51.4	10.5	12.3	15.5	0.3	4.1	197.1
DRIED BLOOD		50.1	74.7		17.1		88.8	15.2	25.1	35.6		7.8	314.4
DRIED WHOLE EGGS		2.8	4.8	0.4	14.2	0.1	5.4	5.1	2.6	5.5	0.1	3.6	44.5
D-TRANS ALLETHRIN		2.7	2.9	0.8	3.3	0.1	7.3	6.0	2.1	5.1	0.1	1.3	31.6
EPTC					48.0			24064.0		160.0			24272.0
ETHABOXAM		3.5	51.6		4.2		63.1	235.6	5.2	25.1		216.1	604.4
ETHALFLURALIN		1553.5	36677.9		5269.5	2415.1	14345.8	67506.8	711.3	21273.4	280.1	21025.5	171058.8
ETHAMETSULFURON-METHYL		9.1	0.6		2.4		3.4	94.8	4.8	7.0	0.7	14.9	137.6
ETHEPHON	112.8	458.4	578.4		185.5		122.4	3724.8		1053.6	4.8	1298.4	7539.1
ETHOFUMESATE								369.6					369.6
ETRIDIAZOLE	0.9	0.001	0.001	0.0003	5.5	0.0001	0.003	0.002	0.002	0.002	0.00005	0.0003	6.4
EXTRACT OF *REYNOUTRIA SACHALINENSIS*	4.0												4.0
FATTY ACID		2.0	2.1	0.1	0.8		1.2	1.6	0.03				7.8
FENAMIDONE								1.0					1.0
FENBUTATIN OXIDE	3.0				2.0								5.0
FENHEXAMID	0.5							1.0					1.5
FENOXAPROP-P-ETHYL		1900.1	3545.3	3117.8	1381.0	495.0	4584.5	8687.8	4722.6	4437.7	2518.1	1667.5	37057.4
FENPYROXIMATE					0.8								0.8
FERRIC PHOSPHATE		1.0	1.0	0.3	3.1		8.3	0.6	1.4	0.8	0.02	0.5	17.0
FERRIC SODIUM EDTA		3.8	2.1	2.7	13.4		29.4	4.4	4.7	6.7		1.1	68.1
FERROUS SULFATE	5904.6	57.7	13.7	4.7	431.3		231.3	5.9	15.3	21.0		9.7	6695.0
FISH MEAL MIXTURE		11.3	17.5	1.5	57.7	0.5	21.6	18.4	9.4	21.5	0.4	13.6	173.3
FISH OIL MIXTURE		0.6	0.9	0.1	3.0	0.02	1.1	0.9	0.5	1.1	0.02	0.7	8.9
FLONICAMID	50.7		20.4		24.5		4.8	47.6		20.7		11.2	179.9
FLORASULAM	863.8	322.4	2547.4	52.6	1128.8	35.6	2143.2	2423.2	1261.4	2011.7	265.9	187.6	13243.6
FLUAZIFOP-P-BUTYL					1.0								1.0
FLUAZINAM	40.0		40.0		260.0		16.0	1972.0		24.0		612.0	2964.0
FLUCARBAZONE SODIUM		410.5	2173.1	13.2	282.3	0.9	2762.2	347.9	1391.8	641.4	69.8	53.4	8146.6
FLUDIOXONIL	703.5	196.9	1354.7	6.9	1034.4	32.9	4100.6	3080.3	507.8	655.9	19.8	426.1	12119.9
FLUMIOXAZIN	157.7	105.4	168.2	13.9	453.2	134.6	500.1	2868.0	171.7	970.5	36.4	616.3	6195.9

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
FLUOPICOLIDE								8.2					8.2
FLUOPYRAM	23.0				20.0			1605.9				447.7	2096.6
FLUOXASTROBIN	245.8	0.5	76.8	0.2	4.8		121.0	41.4	11.6	74.2		23.0	599.4
FLUPYRADIFURONE	2.8				0.8			0.4					4.0
FLUROXYPYR		6810.4	40820.7	352.9	21160.3	3159.0	45348.0	65719.0	22327.3	34073.0	4428.6	18894.0	263093.3
FLUVALINATE							3.7						3.7
FLUXAPYROXAD		375.5	3741.3	52.4	1950.4	1.6	2600.0	3136.5	2600.5	2543.8	543.7	537.5	18083.2
FOLPET					0.1								0.1
FORMIC ACID							2456.1						2456.1
FOSETYL-AL		24.7			67.8		30.7						123.2
GARLIC OIL		1.9	5.4	0.9	2.4	0.03	9.4	0.5	2.2	2.2	0.001	0.4	25.3
GARLIC POWDER	1.5												1.5
GIBBERELLIC ACID	0.2				0.1			0.1					0.4
GLIOCLADIUM CATENULATUM	11.1												11.1
GLUFOSINATE AMMONIUM		33046.0	315236.9	3669.3	47217.1	1964.3	168857.2	106294.1	141245.8	89924.2	19318.5	23906.8	950680.1
GLYPHOSATE	53858.0	314592.0	1735202.1	45905.9	485963.5	38500.8	1616173.2	1391665.1	1054141.4	1009019.2	210085.7	415289.5	8370396.4
HALAUXIFEN		934.4	6757.3		1326.2		6003.5	1153.7	1928.9	4797.7	871.8	76.6	23850.3
HALOSULFURON					1.9			22.3		0.4		2.3	26.9
HEXAZINONE			24.0					2223.0	1.5	1602.0		126.0	3976.5
HYDRAMETHYLNON					0.3		0.03	0.03		0.03		0.03	0.5
HYDROGEN PEROXIDE	12.8				413.7							102.6	529.1
ICARDIN		68.2	57.0	15.9	50.9	0.3	189.2	16.4	68.7	57.8	1.3	28.5	554.1
IMAZAMETHABENZ		1416.7	595.6		1535.8		1756.1	560.5	884.0	2743.4	518.4	19.4	10030.0
IMAZAMOX		381.6	3547.6	43.1	1184.0	139.6	3119.2	4854.8	2144.3	2695.4	1681.4	1482.4	21273.4
IMAZETHAPYR	3.2	23.5	416.6	8.7	297.2	16.5	347.3	1028.0	176.9	342.4	69.3	287.9	3017.3
IMAZYPYR	36.5	675.1	953.1		77.5		1693.7	388.2	653.5	388.0	580.7	63.2	5509.3
IMIDACLOPRID	37.0	17.2	3039.2		3408.7	164.4	1124.9	6069.9	471.0	2793.9	85.3	1468.2	18679.8
INDAZIFLAM	480.8	38.4	38.0	0.8	11.6		127.2	8.8	19.8	1.6		10.4	737.4
IPCONAZOLE		22.6	485.8	18.6	42.1	9.1	125.2	261.7	8.8	48.9	0.3	46.8	1069.8
IPRODIONE	1656.6	528.4	1428.1	136.2	2237.0		2921.4	2894.8	2630.2	1295.4	1224.6	695.2	17648.1
IRON FeHEDTA	0.9	66.1	30.2	14.6	477.3	1.2	1886.3	61.1	54.7	93.9	1.1	32.3	2719.7

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
ISOFETAMID									6.4				6.4
LACTIC ACID	1.3	0.02			0.1								1.4
LINURON	14.4	4.8	826.6		33.6		288.0	2088.0	28.8	355.2	307.2	662.4	4609.0
MALATHION	636.3	421.9	678.9	709.4	766.5	22.3	2294.0	4460.1	604.7	1728.2	100.0	492.8	12915.0
MALEIC HYDRAZIDE					4.5			576.6					581.1
MANCOZEB	420.0	1.7	57.4		4.0		1679.6	54009.9		561.0		2115.0	58848.5
MANDESTROBIN							0.8		0.8				1.5
MANDIPROPAMID							87.1	205.0				7.6	299.6
MCPA	1653.4	49786.2	180085.8	4541.8	61734.6	755.6	208597.0	109504.7	142401.6	126790.4	23026.9	17999.7	926877.6
MCPB		120.0	192.0					183.8	153.8	0.8			650.3
MEAT MEAL MIXTURE		1.0	1.8	0.1	5.0	0.04	1.9	2.0	1.0	2.0	0.03	1.3	16.3
MECOPROP-P	2011.4	1079.0	1534.8	412.6	6590.7	32.4	9081.5	3304.6	1592.5	3211.9	177.3	1548.1	31176.8
METOFLUTHRIN		1.5	0.5	0.5	0.5	0.04	3.1	0.4	0.8	0.5	0.1	0.02	7.9
MESOTRIONE	9.2				43.8		41.5						94.5
METALAXYL		312.8	1545.7	22.5	718.0	51.7	1620.6	1992.3	807.8	1313.8	144.4	396.7	8926.3
METALAXYL-M	8.1	275.5	1964.2	10.7	625.2	43.4	5274.4	4776.6	799.9	810.9	38.3	556.1	15183.3
METALDEHYDE	1.7	0.2	0.4		0.5		2.7	0.7	0.5	0.3	0.03		7.0
METARHIZIUM ANISOPLIAE (STRAIN F52)	0.1												0.1
METCONAZOLE		683.6	5958.5	16.8	734.5	6.4	2403.4	7430.2	407.2	2426.0	111.4	2510.8	22689.0
METHOMYL	1.7	1.5	2.6	0.2	0.8	0.2	2.8	3.2	1.2	29.7	0.3	0.6	44.7
METHYL ANTHRANILATE	5.5												5.5
METHYL NONYL KETONE		1.2	1.1	0.4	1.0	0.1	3.4	1.6	1.9	2.3	0.1	0.4	13.6
METHYLATED SEED OIL OF SOYBEAN		1621.2	15808.8	987.0	3973.2		15705.9	7704.2	12517.4	1299.2	1064.0	4493.3	65174.2
METIRAM			832.0				22.0	946.0		32.0		2224.0	4056.0
METRIBUZIN		341.5	410.9		239.6	30.0	1052.6	4797.2	237.0	3009.7	154.5	92.3	10365.2
METSULFURON-METHYL	589.3	110.3	280.2	10.2	132.4		542.5	160.6	355.5	281.7	48.2	3538.2	6048.9
MINERAL OIL (HERBICIDAL OR PLANT GROWTH REGULATOR)				544.0			8.0						552.0
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	5382.4	84.6	71.1	28.1	18658.2	5.8	17340.7	6707.2	120.8	101.4		33.5	48533.8
MONO- AND DI-POTASSIUM SALT OF PHOSPHOROUS ACID								45465.7					45465.7

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
MONO- AND DIBASIC SODIUM, POTASSIUM, AND AMMONIUM PHOSPHITES								23819.3					23819.3
MUSTARD SEED POWDER (*BRASSICA HIRTA)*	141.1	3.5	35.7		17.4		456.9	149.8		108.9		5.2	918.7
MYCLOBUTANIL	11.0				8.1							0.2	19.3
NALED			3.3					587.9		19.6		58.8	669.5
N-ALKYL (40% C12, 50% C14, 10% C16) DIMETHYL BENZYL AMMONIUM CHLORIDE		52.5	53.6	8.3	25.2	1.1	37.8	197.2	106.5	48.8			531.0
N-ALKYL (5% C12, 60% C14, 30% C16, 5% C18) DIMETHYL BENZYL AMMONIUM CHLORIDE		11.1	19.2	6.0	6.0		9.1	11.1	33.3	7.1			102.8
N-ALKYL (68% C12, 32% C14) DIMETHYL ETHYLBENZYL AMMONIUM CHLORIDE		11.1	19.2	6.0	6.0		9.1	11.1	33.3	7.1			102.8
NAPROPAMIDE	5.4		18.0		56.5		36.5	126.9		4.5		3.6	251.4
NICOSULFURON		0.4	7.6		10.0		4.1	28.8		10.3		7.0	68.2
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	15.0	13.3	19.9	3.2	25.9	0.4	50.8	16.4	25.7	20.4	3.6	6.1	200.8
NONYLPHENOXYPOLYETHOXYETHANOL		870.8	10637.3	2.8	6642.2	540.0	15252.4	14051.5	4220.5	13716.9	1981.2	4643.9	72559.3
NOVALURON		0.002	0.001	0.001	0.003		0.01	0.001	0.002	0.001		0.0003	0.02
OCTADEC-9-ENOIC ACID	36.1	108.3	294.8				2752.3	60.2	1574.7	108.3		601.6	5536.2
OCTYLPHENOXYPOLYETHOXYETHANOL	9.5		429.1		301.5		3.8			22.7			766.5
OIL OF BLACK PEPPER	0.4	2.5	2.8	0.7	7.4	0.1	7.1	3.2	1.8	3.2	0.02	0.8	30.1
OXADIAZON	9.1				0.5								9.5
OXALIC ACID DIHYDRATE							282.3						282.3
OXATHIAPIPROLIN								11.6	0.1				11.7
PACLOBUTRAZOL	1.2				0.2								1.4
PARADICHLOROBENZENE		543.9	292.8	163.3	389.8	20.5	816.1	378.2	483.7	408.8	7.6	72.7	3577.4
PARAFFIN BASE MINERAL OIL (ADJUVANT)	3628.1	1473.8	9761.0	109.0	4305.4	328.2	14700.3	12614.8	4621.7	7978.7	1837.8	5905.9	67264.6
PARAFFIN BASE PETROLEUM OIL		4300.8	5568.0	86.4	4893.6	888.0	12816.0	52747.2	32071.2	13478.4	1128.0	11858.4	139836.0
PARAQUAT					1.0			0.4		2.6		1.0	5.0
PENDIMETHALIN								737.0					737.0
PENFLUFEN		59.6	431.3	6.4	195.5	9.5	406.2	1424.3	451.4	260.0	38.8	81.8	3364.9
PENTHIOPYRAD					3.7		38.0	7.7					49.4
PERACETIC ACID												9.5	9.5
PERMETHRIN	280.8	213.6	98.0	37.2	669.8	1.3	865.1	274.6	142.2	333.7	10.8	174.1	3101.2

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
PETROLEUM HYDROCARBON BLEND		6245.1	54846.0	915.3	27900.7	3155.0	61015.2	100518.6	32176.7	54364.7	18243.6	38575.3	397956.2
PHENMEDIPHAM					9.2			4.6		32.1			45.9
PHORATE								6096.1		70.4			6166.5
PICLORAM	69.2	493.4	1230.6	30.2	784.4		2638.8	944.3	1733.2	1512.4	173.0	31.5	9641.1
PICOXYSTROBIN		1608.0	297.6		249.6		1089.6	3974.6	948.0	362.4		1536.4	10066.2
PINOXADEN		3397.5	11292.7	40.9	6348.3	201.8	14013.2	11995.8	7621.8	11895.1	621.3	2930.8	70359.2
PIPERINE	0.02	0.2	0.3	0.1	0.9	0.02	0.7	0.3	0.1	0.3	0.001	0.1	3.1
PIPERONYL BUTOXIDE	112.1	90.8	116.3	18.1	123.8	2.5	345.9	155.1	132.3	139.4	7.6	34.4	1278.4
P-MENTHANE-3, 8-DIOL		4.4	1.6	1.0	14.7		21.1	1.3	1.6	1.9		0.8	48.5
POLY[OXYETHYLENE(DIMETHYLIMINIO)ETHYLENE(DIMETHYLIMINIO)ETHYLENE DICHLORIDE]		11.2	0.6		0.7			2.2	0.4	2.8	1.1		19.2
POLYMERIZED BUTENES			0.4		1.3			1.8		3.1			6.6
POLYOXIN D ZINC SALT			0.7				0.4			0.5			1.6
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER		4441.5	27123.8	623.7	9641.7	788.4	29851.2	24838.4	18662.4	15781.5	4006.8	5132.7	140892.1
POTASSIUM BICARBONATE	227.8				1.7								229.5
POTASSIUM MONOPERSULPHATE	325.3												325.3
POTASSIUM SALTS OF FATTY ACIDS	79.9	46.8	41.9	7.8	1031.6	0.1	399.3	71.9	51.5	89.9	0.6	60.1	1881.4
PRALLETHRIN		0.1	0.1		0.02		0.2	0.01	0.1	0.02		0.01	0.4
PROHEXADIONE CALCIUM	3.7				1.2								5.0
PROMETRYNE								547.9				576.7	1124.6
PROPAMOCARB HYDROCHLORIDE	249.1	10.9			119.9		5.5						385.3
PROPICONAZOLE	448.4	3386.0	11333.1	562.8	6918.7	106.1	17320.5	12683.2	6519.1	48036.1	629.3	1782.4	109725.6
PROPOXUR									0.1				0.1
PROPYZAMIDE		8.0	8.0		4.0		16.0	56.0	72.0	48.0			212.0
PROTHIOCONAZOLE		7824.8	19706.3	899.1	9593.5	60.9	30855.8	23706.3	18196.5	14155.1	2993.0	5426.2	133417.5
PYMETROZINE	7.8		9.0		3.2		35.1					2.7	57.7
PYRACLOSTROBIN	3.9	1011.3	11799.4	168.7	5679.2	3.2	7552.5	9513.0	6785.3	7646.2	1159.1	1413.0	52734.7
PYRAFLUFEN-ETHYL		188.6	1141.4	270.2	7401.2	1566.9	3313.9	20009.2	4050.6	9322.8	2125.4	11903.2	61293.3
PYRASULFOTOLE		944.3	3399.0	1024.5	1709.4	46.0	4029.9	2692.0	2703.0	4352.4	707.0	456.8	22064.2
PYRAZON							216.2						216.2
PYRETHRINS	20.5	17.3	20.7	4.5	29.7	0.4	64.9	21.8	26.3	23.3	1.8	5.8	237.0

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
PYRIDABEN	1.1				2.5								3.6
PYRIMETHANIL								2255.4					2255.4
PYRIPROXYFEN		0.0002	0.0003	0.001	0.5		0.0002	0.001	0.001	0.001			0.5
PYROXASULFONE	194.2	33.8	472.6		446.3	40.1	575.0	2767.1	14.0	946.0	46.2	2500.9	8036.3
PYROXSULAM		979.9	7790.0		1781.2	127.4	4036.7	11216.8	1626.6	7530.4	424.2	2545.7	38058.8
QUINCLORAC			21.2				1.3	6.0	8.9				37.4
QUIZALOFOP P-ETHYL	221.2	688.1	870.1	13.8	747.3	132.9	2132.7	3787.8	5391.0	2256.8	143.6	1391.6	17776.9
RIMSULFURON		6.2	69.7	1.7	7.9		100.8	244.4	3.1	44.8	26.6	16.6	521.9
SAFLUFENACIL		589.1	4268.7	100.8	1998.5	206.5	4960.7	5861.5	2804.8	3674.1	1051.5	2104.0	27620.3
SEDAXANE		1031.8	2800.5	13.5	918.4	61.9	8269.1	4431.1	1081.2	1130.2	53.1	873.4	20664.1
SETHOXYDIM		248.4	4078.9	44.4	2688.3	266.1	3705.7	11204.7	642.3	3894.7	809.4	2395.6	29978.4
SILICA AEROGEL	60.0		1525.5		1845.0	400.5	1563.3	3946.5	684.0	4185.0	18.0	1026.0	15253.8
SILICON DIOXIDE FRESH WATER FOSSILS		247.3	231.2	52.3	363.0	3.0	873.6	194.7	216.5	213.1	1.9	71.7	2468.3
SILICON DIOXIDE SALT WATER FOSSILS	3916.8	1074.6	976.2	337.3	4306.2	68.8	4884.3	1439.7	1209.7	1927.1	41.3	596.5	20778.6
SILOXYLATED POLYETHER	48.6	48.6			6.1								103.4
SIMAZINE					213.7			1087.3		231.4			1532.3
S-KINOPRENE					0.5								0.5
S-METHOPRENE		0.02	0.03	0.02	1.7	0.01	0.1	0.02	0.04	0.03	0.0002	0.004	1.9
S-METOLACHLOR							18.3	759.5				9.2	786.9
SOAP	57.0	12.0	19.3	9.1	144.7	0.2	131.5	53.5	28.6	41.7	0.4	17.4	515.4
SODIUM ALPHA-OLEFIN SULFONATE	89.6	2.2	22.7		11.1		289.9	95.1		69.1		3.3	582.9
SODIUM CHLORIDE		1.8	1.2	1.4	17.4	0.1	8.0	0.2	0.4	2.0	0.2	0.6	33.4
SODIUM HYPOCHLORITE										12.3			12.3
SPINETORAM					1.7				8.8				10.4
SPINOSAD FACTOR A PLUS	7.5	0.02	0.01	0.02	7.2		0.04	0.03	0.01	0.02		0.003	14.8
SPIRODICLOFEN					2.9								2.9
SPIROMESIFEN	0.7				3.1			39.4				0.5	43.7
SPIROTETRAMAT	10.6		34.1		5.0		110.9	296.6		2.9			460.1
STREPTOMYCES GRISEOVIRIDIS					0.01								0.01
STREPTOMYCES LYDICUS	0.2												0.2
STREPTOMYCIN	3.3				17.2								20.5

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
STRYCHNINE			56.5	2.4	44.4		35.4	175.3		40.0	36.7	63.5	454.2
SULFENTRAZONE		25.5	315.3		716.5	252.5	271.8	7504.0	8.0	1073.6		2608.1	12775.4
SULFOXAFLOR		61.6	424.3	16.0	83.0		516.8	320.0	807.3	142.6	54.1	24.0	2449.8
SULPHUR (FUNGICIDE)	587.0	53.0	82.7	27.2	847.4	3.0	295.5	64.1	66.2	70.1	3.7	95.2	2195.2
SULPHUR (VERTEBRATE CONTROL)	257.8	28.7	155.4	8.2	576.0	0.6	546.1	105.8	3.4	169.3		23.6	1874.9
SURFACTANT BLEND	2433.4	25552.9	95557.6	2568.8	43605.3	5553.4	122992.3	187802.5	102093.8	90246.1	23483.8	61085.1	762533.3
SURFACTANT MIXTURE	15.4	15.4			1.9								32.6
TALLOW FATTY ACID AMINE ETHOXYLATE		70.4	102.4	12.8			844.8		390.4				1420.8
TEA TREE OIL	1.2												1.2
TEBUCONAZOLE		4591.3	15993.8	569.1	7590.4	18.7	25971.3	7100.0	3441.0	12868.1	2350.4	1149.9	81644.1
TEFLUTHRIN					76.8			5.4				0.6	82.8
TEPRALOXYDIM		0.5	1.9				0.6						3.1
TERBACIL					1.6			97.6	9.6	1.6		374.4	484.8
TETRACHLORVINPHOS		0.9	0.6	0.9	0.1	0.4	1.5	1.3	2.2	1.5		0.3	9.7
TETRAMETHRIN	38.8	11.6	10.5	3.4	60.3	0.3	66.1	11.3	11.3	16.4	0.4	4.9	235.2
THIABENDAZOLE		0.2	6.8	1.0	6.6	12.0	124.6	287.5	0.6	3.9	2.6	111.5	557.2
THIAMETHOXAM	0.2	1278.4	6032.7	197.9	4324.9	211.0	7145.5	12174.0	11920.4	5220.6	548.1	1603.8	50657.7
THIENCARBAZONE METHYL		4.6	267.5	2.4	162.0		215.8	198.5	121.7	244.9	20.3	6.6	1244.2
THIFENSULFURON METHYL		334.0	832.5	67.1	186.5	15.8	1320.6	558.9	968.1	603.9	147.8	374.0	5409.1
THIOPHANATE-METHYL	827.0		0.1	0.1	24.6	0.1	0.2	0.6		3.1			855.8
THIRAM	56.8	73.7	852.2	60.3	740.7	50.2	931.2	1382.7	1077.0	619.9	378.8	267.8	6491.4
THYMOL							22.3						22.3
TOPRAMEZONE		23.4	63.7	3.2	5.8		47.0	381.5		89.5	17.1	49.0	680.3
TRALKOXYDIM	57.6	982.4	8336.8	467.2	4870.4	288.0	13257.6	34421.6	2774.4	13371.7	1408.0	1558.4	81794.1
TRIALLATE		4491.3	54095.3		27191.9	90.3	19436.1	30847.7	1638.6	52557.2	1005.4	31193.2	222547.0
TRIBENURON METHYL		353.2	1345.1	52.8	456.9	18.2	1714.2	1346.1	1138.6	1151.8	271.8	19058.5	26907.2
TRICHLORO-S-TRIAZINETRIONE		79.2	26.4	52.8	156.2		264.0	39.6		118.8			737.0
TRICHODERMA ASPERELLUM, STRAIN T34					0.1								0.1
TRICHODERMA HARZIANUM RIFAI STRAIN KRL-AG2	12.0				0.1								12.1
TRICLOPYR	2132.6	513.4	2372.3	226.5	237.8		4073.0	60.0	1544.9	1381.6	906.0	157.8	13605.9

Active Ingredient	Alberta	Athabasca River	Battle River	Beaver River	Bow River	Milk River	North Sask River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask River	Total
TRIETHANOLAMINE SALTS OF FATTY ACIDS	34.7	6.7	13.4	1.5	62.8		48.5	22.1	8.4	16.9		4.0	219.0
TRIFLOXYSTROBIN	0.6	375.5	3461.8	154.9	1640.5	6.6	4590.7	4555.1	3173.9	2354.0	808.4	916.9	22038.7
TRIFLURALIN		309.3	13222.5		2385.8		1588.0	18840.1	157.0	10091.3	353.5	5259.0	52206.5
TRIFLUSULFURON METHYL								10.2		1.2		0.9	12.2
TRIGLYCERIDE ETHOXYLATE 10 POE	230.4	336.0	881.6		886.4	2486.4	3129.6	4822.4	2355.2	5097.6	998.4	4325.9	25549.9
TRINEXAPAC-ETHYL	54.2				31.6								85.8
TRITICONAZOLE	2.6	23.6	82.5	15.4	101.0		149.0	45.6	19.5	51.8	6.2	10.6	507.8
UNICONAZOLE-P	0.01				0.004								0.02
WARFARIN	0.4	0.1	0.1	0.02	0.3	0.01	0.4	0.1	0.05	0.1	0.001	0.01	1.4
WINTERGREEN OIL		1.4	2.1	0.2	7.2	0.1	2.6	2.1	1.1	2.6	0.1	1.6	21.0
Z-9-TRICOSENE	0.5	0.2	0.5	0.005	0.4	0.004	0.6	0.7	0.2	0.7	0.1	0.2	4.0
ZINC NAPHTHENATE		34.9	13.5	8.5	32.4	1.4	52.4	14.6	31.9	26.1	0.1	0.5	216.3
Total	**140763.5**	**570652.1**	**2999310.8**	**91298.8**	**1128139.9**	**91332.4**	**2968417.2**	**3411761.0**	**1914321.7**	**2073098.9**	**389536.2**	**966006.2**	**16744638.6**