

**SURVEY OF PESTICIDE USE IN ONTARIO, 2013/2014**  
**Estimates of Pesticides Used on Field Crops and**  
**Fruit and Vegetable Crops**

by

**Farm & Food Care Ontario**

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Project Contact Information:

Bruce Kelly  
Farm & Food Care Environmental Program Manager  
Farm & Food Care Ontario  
100 Stone Road West, Suite 202  
Guelph, ON, N1G 5L3  
519-837-1326  
info@farmfoodcare.org

# Introduction

## Introduction

Pesticides, also called pest control products, have been used in Ontario since the end of the Second World War. Pesticides are used to control, suppress or repel pests in order to protect our crops, forests, structures, livestock, pets and human health. In agriculture, the use of pesticides has improved crop quality and contributed to dramatic increases in crop yields for many field, fruit and vegetable crops.

While there are benefits to using pesticides, they need to be used properly and only when needed, in order to minimize potential risks to the environment and human health. Development of appropriate risk mitigation strategies on the use of pesticides requires the collection of pesticide use data for analysis, supported by pesticide education programs and research to develop new methods to reduce pesticide use. Changes in pesticide risk over time is influenced not only by changes in absolute volume applied to the crop but also by other factors such as the substitution of high-risk pesticides with lower-risk formulations, pressure to increase crop production per hectare, and changes in pesticide use strategies on different crops during vulnerable growth stages of each crop.

Ontario holds a unique position across Canada in its efforts to collect detailed pesticide use data on a regular basis from growers. Since 1973, surveys of **agricultural** pesticide use have been carried out every five years by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). The 1983 survey year was chosen as the benchmark year for future comparisons of pesticide use survey data to determine trends in overall pesticide use in the Province. The statistical aspects of these surveys have been handled primarily by the statisticians of OMAFRA's Economic Development Policy Branch. The results appeared in *Survey of Pesticide Use in Ontario, 1973 [1], 1978 [2], 1983 [3], 1988 [4], 1993 [5], 1998 [6], 2003 [7] and 2008 [8]*. While these reports dealt from time to time with non-agricultural use such as roadside spraying and commercial applicators, there has been a consistent focus on pesticide use for agricultural crops.

As was the case in 1998, 2003 and 2008, the 2013/2014 Survey of Pesticide Use included field crops, fruit and vegetable crops, as well as selected other agricultural crops (nursery, sod and ginseng). Data on other types of applications (i.e. roadside spraying) have not been included on this survey occasion.

# Survey of Pesticide Use on Agricultural Crops

## Data Collection Process

All Ontario field crop, vegetable, fruit and specialty crop farmers were encouraged to fill out a confidential survey of pesticide use for the Ontario Ministry of Agriculture, Food and Rural Affairs in 2013 and 2014.

To encourage submissions to the survey, details were distributed in Ontario farming publications, hosted on the Farm & Food Care website and distributed through relevant commodity board meetings, newsletters and events such as Canada's Outdoor Farm Show.

Data collection for the 2013 Pesticide Survey was moved to an online program (website) with drop-down menus for ease of use and to obtain accurate data. This format ensured accuracy of mathematical calculations and tabulation of data as well. The online format allowed submissions to be entered any time allowing farmers to submit data as it became available, reducing the likelihood of omissions. The website was hosted at [www.ontariopesticidesurvey.ca](http://www.ontariopesticidesurvey.ca) and [www.ontariopesticidesurvey.com](http://www.ontariopesticidesurvey.com) to ensure total possible catchment for submissions. No names, addresses, telephone numbers or other personal identifiers accompanied the submissions - the only geographic identifier was the county.

Farm & Food Care also accepted mail-in, fax and email returns of the survey to ensure accessibility in accepting submissions.

Due to a relatively low submission rate in 2013, the online survey was made available through the 2014 growing season and data was analyzed to avoid duplication across the years. A total of 475 online submissions were received over the 2013 and 2014 growing seasons. By comparison, the three previous pesticide surveys in 1998, 2003 and 2008 each received at least 1,200 submissions. Since only 16% of survey entries were based on pesticide applications in 2014, the provincial hectares amounts for 2013 are used to extrapolate the combined 2013/2014 pesticide usage data.

Since online survey respondents could choose between units of acres or hectares, the application rates recorded in the survey data had to be converted accordingly prior to statistical analysis to ensure consistency across all entries. In some cases, such as for herbicide co-packs, the application rate units were not given on a per area basis so additional calculations were required. Quantities of active ingredients for each product were computed by multiplying area treated, application rate and active ingredient concentration.

## Extrapolating the Survey Data

To estimate total pesticide usage on Ontario farms, it is necessary to extrapolate the survey data. As with previous pesticide surveys, this is done using expansion factors. Expansion factors for individual crops are calculated as the ratio of total provincial hectares (in 2013) to hectares reported by survey respondents. Total reported quantities of each pesticide applied are then multiplied by the expansion factor for the applicable crop to estimate the provincial total quantity applied.

Estimated provincial totals are also broken down by county and by region within the province to determine the quantities applied at these geographic levels. These breakdowns are estimated based on the county or region's share of total provincial hectares for specific crops. This approach was used to avoid distortions due to the relatively low response rate for this survey (compared to previous surveys), as there were a number of counties for which survey responses were not received for specific crops. As a result, estimating quantities applied at the provincial level and then allocating these amounts to counties based on areas grown may provide more accurate estimates at this level. However, it must be noted that this approach is based on the assumption that pesticide treatment for a specific crop does not vary substantially with location across the province.

As noted in previous pesticide surveys, the use of samples involves limitations that exist where specific pesticides or crops are not adequately represented. In these cases, pesticide use cannot be estimated; as a result, pesticide use may appear to be zero when, in reality, it is likely to have been applied. These limitations may be augmented by the lower response rate for this survey.

Due to the low response rate, there is also a greater possibility that the results are affected by individual respondents, particularly for minor crops for which very few entries were recorded. For example, there were only two respondents who produced ginseng. If these producers applied pesticides at a higher rate than the industry average, this would bias the extrapolated results upward.

### **Additional Notes**

As with all recent versions of this survey, the scope of the 2013 Pesticide Survey provides a measure of the agricultural use of pesticides on field crops as well as field-grown fruit and vegetable crops. While the 1998, 2003 and 2008 surveys also included a category for estimates of pesticide use on other agricultural crops (nursery, sod and ginseng), there were not enough observations of these crops in the 2013 survey data to create a separate category. As a result, these crops are included in the field crops category under "other field crops".

Due to relatively few respondents for some field crops, specific crops were aggregated prior to extrapolation. As a result, there are fewer field crop subcategories than in previous surveys. For example, hay and pasture are combined, while rye, other dry beans, tobacco, and sugar beets are included in "other field crops". In addition, oats and mixed grains were combined into one category for the survey itself.

This survey did not include a separate pesticide category for nematocides, as had been the case in previous surveys. Instead, nematocides are included in the fungicide category.

Greenhouse spraying is not included in this survey. Surfactants (oils), seed treatments and other types of agricultural pesticide use such as livestock sprays and rodenticides are also excluded.

# Summary of Results

## Presentation

Following the format of previous pesticide survey reports, the results of the 2013/14 survey are presented in tabular form in Appendices II through X. Specific pesticides have been listed by their common names in the tables to avoid bias towards trade names. Appendix VI lists the common names reported in the survey.

Appendix II shows the total amount of active ingredient (a.i.) of each pesticide used for specific field crops in Ontario. Breakdowns for each specific pesticide used on total fruit and total vegetables appear in Appendices III and IV, respectively.

Total pesticide use on all surveyed crops is summarized in Appendix V (by crop or crop grouping), Appendix VI (by specific pesticide) and Appendix VII (by region or county).

Appendices VIII and IX compare results of the 2013/14 pesticide survey for selected crops and selected pesticides with the results from previous surveys conducted in 1983, 1988, 1993, 1998, 2003, and 2008.

Appendix X shows herbicide use compared to unit of production for field corn, soybeans and wheat, in this case the active ingredient per 1000 bushels grown.

Finally, in cases where amounts of product used were low (i.e. under 200 kg a.i.), the estimates of pesticide use have been aggregated. Although reported as "other", these pesticides were still included in the total amounts used. Totals shown throughout the tables may not add to 100% due to rounding.

## Highlights

Changes in pesticide risk over time are influenced not only by changes in absolute volume or weight of products applied to the crop but also by the environmental impact of these products. Survey results show that farmers are using pesticides with lower risk formulations as these products become available. See Environmental Impact of Pesticide Use in Ontario: 2013/2014 Pesticide Survey for more information on pesticide risk.

Based on the sample size of this survey the results should be viewed within a  $\pm 4\%$  margin of error.

### **Pesticide usage is affected by shifts in the types of crops grown from year to year.**

Provincial commodity numbers show that between the 2008 and 2013 surveys there was a decrease in beef production and subsequent shift away from pasture crops to field crops.

- 22% increase in the hectares planted in field corn (180,000 more hectares than in 2008)
- 24% increase in the hectares planted in soybeans (202,000 more hectares than in 2008)
- 24% reduction in the hectares planted in wheat (109,000 less hectares)
- 28% reduction in the hectares planted in hay (223,000 less hectares)

### **There has been a significant reduction in pesticide use across many categories of products between 2008 and 2013.**

- 46% reduction of overall insecticide usage
- 64% reduction of organophosphate insecticide usage
- 35% reduction of atrazine application on field corn

### **There has been significant reduction in pesticide usage over the past 30 years and a shift away from atrazine.**

- 38% reduction of overall pesticide usage
- 83% reduction of atrazine application on field corn

**Changes in overall pesticide usage per hectare differ by crop category.**

- 34% decrease in pesticide usage in vegetable production (2008-2013)
- 26% decrease in pesticide usage in milling grain production (wheat, oats, barley)
- 5% increase in pesticide usage in soybean production
- 11% increase in pesticide usage in field corn production

**Less herbicides are being used per unit of production (See Appendix X)**

- 68% reduction per bushel of field corn since 1983
- 64% reduction per bushel of soybeans since 1983
- 10% reduction per bushel of wheat since 1998

From 2008 to 2013, the overall pesticide usage (gross amount by kg of active ingredients) has increased by 12.4% and this is largely driven by an increase in the overall hectares planted in corn (22%) and soybeans (24%), as well as an increased use of glyphosate products on field corn. Glyphosate currently accounts for 54% of pesticides applied in Ontario and the majority of this glyphosate is used in the production of field corn and soybeans. Increased use of glyphosate in corn and soy is likely attributable to the increased use of glyphosate-tolerant seed varieties and increased adoption of conservation tillage practices.

In order to contextualize this data, it is important to consider:

- Glyphosate has one of the lowest environmental hazard ratings, with an Environmental Impact Quotient (EIQ) of 15.3 (see Environmental Impact of Pesticide Use in Ontario: 2013/2014 Pesticide Survey.) Since 2008 the standard concentration of active ingredients in glyphosate has increased from 360 grams/L to 540 grams/L. This may account for some of the increase in active ingredient usage.
- For weed control, Ontario farmers may use multiple (2X) applications of glyphosate to control weeds in corn, instead of using an atrazine mix at pre-emergence, because they view glyphosate as a better alternative, with no impact on future crop rotation options.
- Glyphosate has come to be used as a desiccant to synchronize crop maturity for harvest.
- With increased usage of environmentally friendly cover crops and conservation tillage practices, glyphosate has become the choice for weed management and seed bed preparation.

A 12.4% increase in overall pesticide usage continues the slight upward trend in total pesticide use that has occurred since 2003, but still represents a decrease of 38% in pesticide usage since 1983 (see Figure 1 on page 18), and a shift toward products that are safer for the environment and workers. Field crops make up the overwhelming majority of cultivated farmland in Ontario and also account for 87% of the pesticides used in agricultural production, despite the fact that the total active ingredients used per hectare (1.23kg/ha) is less than fruit (27.88kg/ha) and vegetable (3.59kg/ha) production.

According to this 2013 survey, s-metolachlor (primarily applied to soybeans and corn) accounts for 14% of the total pesticides currently used and the usage of s-metolachlor has increased primarily on soybeans.

There was an increase from 2008 to 2013 in fungicide usage for field crops, particularly for corn and soybeans. This was likely due to an increase in summer rainfall in 2013 and incidence of white mould in soybeans and northern corn leaf blight in field corn.

**Additional Notes**

Due to the relatively low response rate for the 2013 survey, the extrapolated results for pesticide usage in the province should be used as an indicator of activity and trends and not as an exact measure of use. For crops with few respondents, there is greater potential for bias in estimated pesticide usage.



Conversely, for the major crops such as corn and soybeans with larger numbers of respondents, the likelihood of such bias is reduced. In general, the lower the number of respondents, the greater the margin of error will be in the estimated pesticide usage, the margin of error in the estimated pesticide usage for 2013 would be  $\pm 4\%$  vs  $\pm 2\%$  in the 2008 survey, which may affect the ability to accurately compare estimated pesticide usage in 2013 with that of previous years.

# Appendices

## Appendix I. Example of Methodology Used in the Estimation of Pesticide Use at the Provincial and County Levels

Note: The following description is derived from the 2008 survey [8], with adjustments made based on 2013 data.

### For All Crops in the Survey

The expansion factor for each crop is the ratio of the total area of each crop to the area of that crop (sprayed or not) reported in the survey.

Example: Calculation of expansion factor for soybeans

Total area of soybeans in 2013: 2,600,000 acres

Total area of soybeans reported in survey: 30,845.1 acres

Therefore, the expansion factor for soybeans is:  $2,600,000 / 30,845.1 = 84.292$

For each record in the sample, the quantity of a.i. of all pesticides was computed by multiplying area sprayed times concentration times application rate. The sample total for each pesticide used was then multiplied by the expansion factor for the corresponding treated crop to arrive at an estimate of the total quantity of active ingredient for a particular pesticide used.

Example: Estimation of s-metolachlor used on soybeans in the province

Total quantity of active ingredient of s-metolachlor used on soybeans in the sample was 2,225.367 kg.

Therefore, the total quantity of active ingredient of s-metolachlor used on soybeans would be:

$$2,225.367 \times 84.292 = 187,581 \text{ kg}$$

(This is the figure that appears in Appendix II).

Once the provincial level estimate of pesticide usage was determined, the total was allocated to counties on the basis of area grown.

Example: Estimation of s-metolachlor used on soybeans in Lambton County

The area grown to soybeans in Lambton County (270,974 acres in 2013) accounted for 10.4% of the provincial total.

Therefore, the total quantity of active ingredient of s-metolachlor used on soybeans in Lambton County would be:

$$0.104 \times 187,581 = 19,508 \text{ kg}$$

(This represents the share that s-metolachlor use on soybeans contributes to the Lambton County estimate for "Herbicides" which appears in Appendix VII).

**Appendix II. Quantities of Specific Pesticide Active Ingredients Used on Field Crops in Ontario, 2013/14**

<b>Pesticide by Crop</b>	<b>Quantity</b>	<b>Pesticide by Crop</b>	<b>Quantity</b>	<b>Pesticide by Crop</b>	<b>Quantity</b>
<b>Herbicides</b>	<b>kilograms</b>	<b>Herbicides (cont'd)</b>	<b>kilograms</b>	<b>Herbicides (cont'd)</b>	<b>kilograms</b>
<b>Field Corn</b>		<b>Barley</b>		<b>Wheat</b>	
atrazine	293,208	2,4-DB	2,123	2,4-D amines	20,492
bentazon	341	bromoxynil	6,867	2,4-D ester	23,556
bromoxynil	1,350	fenoxaprop-p-ethyl	291	2,4-DB	3,242
dicamba	22,722	MCPA/MCPB	12,639	bromoxynil	50,952
diflufenzopyr	779	other	110	dicamba	1,353
dimethenamid-P	47,763	<b>Total</b>	<b>22,030</b>	dichlorprop	7,907
glufosinate	9,171			glyphosate	65,230
glyphosate	1,151,051	<b>Canola</b>		MCPA/MCPB	59,740
isoxaflutole	671	glufosinate	3,927	pyrasulfotole	13,920
mesotrione	39,352	glyphosate	26,646	thifensulfuron-methyl	367
nicosulfuron	271	other	25	other	464
pendimethalin	7,592	<b>Total</b>	<b>30,598</b>	<b>Total</b>	<b>247,224</b>
s-metolachlor	547,774				
saflufenacil	3,612	<b>Hay &amp; Pasture</b>		<b>Other Field Crops</b>	
other	261	2,4-D amines	3,379	2,4-D amines	4,636
<b>Total</b>	<b>2,125,918</b>	glyphosate	27,980	2,4-D ester	1,470
		MCPA/MCPB	1,482	bromoxynil	735
<b>Soybeans</b>		<b>Total</b>	<b>32,842</b>	flumioxazin	346
bentazon	13,845			glyphosate	24,144
chlorimuron	1,172	<b>Oats &amp; Mixed Grain</b>		linuron	3,010
chlorimuron-ethyl	220	glyphosate	34,573	MCPA/MCPB	1,733
dimethenamid-P	12,571	MCPA/MCPB	11,837	s-metolachlor	7,412
fluazifop-p-butyl	6,546	other	155	other	210
flumetsulam	5,767	<b>Total</b>	<b>46,565</b>	<b>Total</b>	<b>43,695</b>
flumioxazin	2,079				
fomesafen	9,357	<b>White Beans</b>		<b>Total Herbicides</b>	<b>4,470,072</b>
glyphosate	1,544,954	bentazon	1,752		
imazethapyr	13,230	fomesafen	752		
metribuzin	85,071	glyphosate	11,542		
quizalofop-p-ethyl	906	imazethapyr	427		
s-metolachlor	187,581	s-metolachlor	12,244		
saflufenacil	355	trifluralin	10,635		
other	55	other	138		
<b>Total</b>	<b>1,883,711</b>	<b>Total</b>	<b>37,489</b>		

**Appendix II. Quantities of Specific Pesticide Active Ingredients Used on Field Crops in Ontario, 2013/14 (cont'd)**

<b>Pesticide by Crop</b>	<b>Quantity</b>	<b>Pesticide by Crop</b>	<b>Quantity</b>	<b>Pesticide by Crop</b>	<b>Quantity</b>
<b>Fungicides</b>	<b>kilograms</b>	<b>Fungicides (cont'd)</b>	<b>kilograms</b>	<b>Insecticides</b>	<b>kilograms</b>
<b>Barley</b>		<b>Wheat</b>		<b>Barley</b>	
prothioconazole	310	azoxystrobin	1,912	dimethoate	686
pyraclostrobin	389	metconazole	8,460	<b>Total</b>	<b>686</b>
tebuconazole	310	picoxystrobin	5,279	<b>White Beans</b>	
<b>Total</b>	<b>1,008</b>	propiconazole	8,703	malathion	1,567
<b>Canola</b>		prothioconazole	9,131	<b>Total</b>	<b>1,567</b>
prothioconazole	1,228	pyraclostrobin	11,679	<b>Other Field Crops</b>	
<b>Total</b>	<b>1,228</b>	tebuconazole	8,534	lambda-cyhalothrin	228
<b>Field Corn</b>		trifloxystrobin	4,254	other	228
azoxystrobin	8,433	<b>Total</b>	<b>57,951</b>	<b>Total</b>	<b>456</b>
picoxystrobin	1,149	<b>White Beans</b>		<b>Total Insecticides</b>	<b>2,709</b>
propiconazole	14,055	fluazinam	3,005	<b>Total Pesticides Used</b>	<b>4,690,592</b>
prothioconazole	2,298	pyraclostrobin	1,219	<b>on Field Crops</b>	
pyraclostrobin	2,892	<b>Total</b>	<b>4,224</b>		
<b>Total</b>	<b>28,827</b>	<b>Other Field Crops</b>			
<b>Oats &amp; Mixed Grain</b>		azoxystrobin	347		
propiconazole	436	chlorothalonil	15,405		
trifloxystrobin	436	copper hydroxide	8,818		
<b>Total</b>	<b>872</b>	cyprodinil	811		
<b>Soybeans</b>		fluazinam	2,748		
azoxystrobin	3,296	fludioxonil	540		
fluxapyroxad	1,899	fosetyl-AL	38,267		
picoxystrobin	3,049	iprodione	1,390		
propiconazole	6,740	mancozeb	32,239		
pyraclostrobin	6,904	<b>Total</b>	<b>100,566</b>		
trifloxystrobin	1,246	<b>Total Fungicides</b>	<b>217,811</b>		
<b>Total</b>	<b>23,135</b>				

**Appendix III. Quantities of Specific Pesticide Active Ingredients Used on All Fruit in Ontario, 2013/14**

<b>Pesticide Used</b>	<b>Quantity (kg)</b>	<b>Pesticide Used</b>	<b>Quantity (kg)</b>
<b>Insecticides</b>		<b>Fungicides</b>	
acetamiprid	763	<i>Bacillus subtilis</i>	2,050
chlorpyrifos	850	boscalid	1,336
diazinon	1,331	captan	88,851
dimethoate	875	chloropicrin	49,107
endosulfan	1,187	chlorothalonil	9,331
imidacloprid	272	copper sulphate	690
malathion	2,419	cyprodinil	427
oxamyl	634	fenhexamid	10,162
phosalone	376	ferbam	2,539
phosmet	6,771	fluazinam	304
spirodiclofen	274	fludioxonil	282
other	980	fluopyram	664
<b>Total</b>	<b>16,734</b>	folpet	492
		fosetyl-AL	2,861
		iprodione	1,059
		mancozeb	216,037
		metiram	1,948
		phosphorous acid salts	1,860
<b>Herbicides</b>		myclobutanil	356
2,4-D amines	930	penthiopyrad	2,297
chlorthal dimethyl	987	potassium bicarbonate	210
glufosinate ammonium	2,708	pyraclostrobin	799
glyphosate	13,194	pyrimethanil	3,004
napropamide	3,840	<i>Reynoutria sachalinensis</i>	456
paraquat	1,274	streptomycin sulphate	352
s-metolachlor	1,478	sulphur	55,352
terbacil	564	thiophanate-methyl	225
other	684	other	970
<b>Total</b>	<b>25,659</b>	<b>Total</b>	<b>454,023</b>
<b>Growth Regulators</b>		<b>Total Pesticides Used on Fruit</b>	<b>502,515</b>
6-benzyladenine	576		
carbaryl	4,908		
ethephon	313		
other	303		
<b>Total</b>	<b>6,100</b>		

**Appendix IV. Quantities of Specific Pesticide Active Ingredients Used on All Vegetables in Ontario, 2013/14**

<b>Pesticide Used</b>	<b>Quantity (kg)</b>	<b>Pesticide Used</b>	<b>Quantity (kg)</b>
<b>Insecticides</b>		<b>Herbicides</b>	
carbaryl	1,037	atrazine	4,394
chlorantraniliprole	314	bromoxynil	426
chlorpyrifos	1,462	clomazone	506
deltamethrin	298	dimethenamid-P	2,284
diazinon	3,091	diquat	5,197
endosulfan	1,332	diuron	3,162
imidacloprid	231	fluazifop-p-butyl	369
malathion	872	fomesafen	331
potassium salts of fatty acids	28,663	glufosinate ammonium	840
spirotetramat	219	glyphosate	9,869
other	568	imazethapyr	467
<b>Total</b>	<b>38,086</b>	linuron	18,531
<b>Fungicides</b>		mesotrione	370
azoxystrobin	3,282	metribuzin	5,850
chlorothalonil	74,550	napropamide	423
difenoconazole	1,840	oxyfluorfen	365
iprodione	7,749	paraquat	690
mancozeb	7,766	s-metolachlor	12,316
metiram	4,204	saflufenacil	259
penthiopyrad	210	trifluralin	2,012
pyraclostrobin	700	other	384
pyrimethanil	1,973	<b>Total</b>	<b>69,047</b>
<i>Reynoutria sachalinensis</i>	203	<b>Total Pesticides Used</b>	
other	320	<b>on Vegetables</b>	<b>209,930</b>
<b>Total</b>	<b>102,797</b>		

**Appendix V. Quantities of Active Ingredients of Each Type of Pesticide Used on All Surveyed Crops in Ontario, 2013/14**

Crop	Herbicides					Insecticides	Fungicides	Growth Regulators	Total Pesticides	Percentage of Usage by Crop
	Auxinic <sup>b</sup>	Chloro-acetamide	Glycine	Triazine	Other					
	- tonnes -									%
Field Corn	22.7	595.5	1,151.1	293.2	63.4	-	28.8	-	<b>2,154.7</b>	39.9
Soybeans	-	200.2	1,545.0	85.1	53.5	0.2	23.1	-	<b>1,907.0</b>	35.3
White Beans	-	12.2	11.5	-	13.7	1.6	4.2	-	<b>43.3</b>	0.8
Grains <sup>a</sup>	143.1	-	99.8	-	72.9	0.7	59.8	-	<b>376.3</b>	7.0
Hay and Pasture	4.9	-	28.0	-	-	-	-	-	<b>32.9</b>	0.6
Other Field Crops	7.8	7.4	50.8	-	8.2	0.3	101.8	-	<b>176.4</b>	3.3
<b>Field Crops</b>	<b>178.5</b>	<b>815.3</b>	<b>2,886.1</b>	<b>378.3</b>	<b>211.8</b>	<b>2.7</b>	<b>217.8</b>	-	<b>4,690.6</b>	<b>86.8</b>
Fruit	1.9	1.5	13.2	0.2	8.9	16.7	454.0	6.1	<b>502.5</b>	9.3
Vegetables	-	14.6	9.9	10.2	34.3	38.1	102.8	-	<b>209.9</b>	3.9
<b>All Surveyed Crops</b>	<b>180.4</b>	<b>831.4</b>	<b>2,909.2</b>	<b>388.8</b>	<b>255.0</b>	<b>57.5</b>	<b>774.6</b>	<b>6.1</b>	<b>5,403.0</b>	<b>100.0</b>
<b>% of Usage by Pesticide Grouping</b>	<b>3.3</b>	<b>15.4</b>	<b>53.8</b>	<b>7.2</b>	<b>4.7</b>	<b>1.1</b>	<b>14.3</b>	<b>0.1</b>	<b>100.0</b>	

<sup>a</sup> Includes wheat, barley, oats and mixed grain.

<sup>b</sup> Includes phenoxy herbicides.

Note: Totals may not add due to rounding.

## Appendix VI. Quantities of Specific Pesticide Active Ingredients Used on All Surveyed Crops in Ontario, 2013/14

Pesticide Used	Quantity (kg)	Pesticide Used	Quantity (kg)	Pesticide Used	Quantity (kg)
<b>Auxinic Herbicides<sup>a</sup></b>		<b>Insecticides</b>		<b>Fungicides</b>	
2,4-D amines	29,437	acetamiprid	772	azoxystrobin	17,312
2,4-D ester	25,026	carbaryl	1,037	<i>Bacillus subtilis</i>	2,050
2,4-DB	5,365	chlorantraniliprole	585	boscalid	1,336
chlorthal dimethyl	987	chlorpyrifos	2,311	captan	88,851
dicamba	24,075	deltamethrin	315	chloropicrin	49,107
dichlorprop	7,907	diazinon	4,422	chlorothalonil	99,286
MCPA/MCPB	87,431	dimethoate	1,561	copper hydroxide	8,818
other	200	endosulfan	2,519	copper sulphate	806
<b>Total</b>	<b>180,428</b>	imidacloprid	504	cyprodinil	1,238
<b>Chloroacetamide Herbicides</b>		lambda-cyhalothrin	368	difenoconazole	1,866
dimethenamid-P	62,618	malathion	4,858	fenhexamid	10,162
s-metolachlor	768,804	oxamyl	634	ferbam	2,539
<b>Total</b>	<b>831,422</b>	permethrin	231	fluazinam	6,058
<b>Glycine Herbicides</b>		phosalone	376	fludioxonil	823
glyphosate	2,909,184	phosmet	6,771	fluopyram	664
<b>Total</b>	<b>2,909,184</b>	potassium salts	28,663	fluxapyroxad	1,899
<b>Triazine Herbicides</b>		spinetoram	319	folpet	492
atrazine	297,603	spirodiclofen	274	fosetyl-AL	41,128
metribuzin	90,922	spirotetramat	288	iprodione	10,198
simazine	231	other	720	mancozeb	256,042
<b>Total</b>	<b>388,756</b>	<b>Total</b>	<b>57,529</b>	metconazole	8,460
<b>Other Herbicides</b>		<b>Growth Regulators</b>		metiram	6,152
bentazon	15,938	6-benzyladenine	576	phosphorous acid salts	1,860
bromoxynil	60,330	carbaryl	4,908	myclobutanil	373
chlorimuron	1,172	ethephon	313	penthiopyrad	2,507
chlorimuron-ethyl	220	other	303	picoxystrobin	9,478
clomazone	506	<b>Total</b>	<b>6,100</b>	potassium bicarbonate	210
diflufenzopyr	779			propiconazole	30,103
diquat	5,197			prothioconazole	12,966
diuron	3,162			pyraclostrobin	24,583
fenoxaprop-p-ethyl	415			pyrimethanil	4,977
fluzifop-p-butyl	6,933			<i>Reynoutria sachalinensis</i>	659
flumetsulam	5,767			streptomycin sulphate	352
flumioxazin	2,611			sulphur	55,352
fomesafen	10,441			tebuconazole	8,843
glufosinate	13,098			thiophanate-methyl	225
glufosinate ammonium	3,548			trifloxystrobin	5,982
imazethapyr	14,288			other	874
isoxaflutole	671			<b>Total</b>	<b>774,631</b>
linuron	21,542			<b>Total All Pesticides</b>	<b>5,403,037</b>
mesotrione	39,816				
napropamide	4,263				
nicosulfuron	301				
oxyfluorfen	365				
paraquat	1,964				
pendimethalin	7,592				
pyrasulfotole	13,920				
quizalofop-p-ethyl	945				
safinacil	4,226				
terbacil	564				
thifensulfuron-methyl	548				
tribenuron	272				
trifluralin	12,646				
other	945				
<b>Total</b>	<b>254,987</b>				

<sup>a</sup> Includes phenoxy herbicides



**Appendix VII. Quantities of Active Ingredients of Each Type of Pesticide Used on All Surveyed Crops in 2013/14, by Region and County, Ontario**

	<b>Herbicides</b>	<b>Insecticides</b>	<b>Fungicides</b>	<b>Growth Regulators</b>	<b>Total Pesticides</b>
	<b>- tonnes -</b>				
Brant	88.1	1.5	12.9	-	102.5
Chatham-Kent	276.3	8.6	42.5	-	327.5
Elgin	219.2	3.9	31.3	-	254.7
Essex	154.6	3.5	40.8	0.4	199.3
Haldimand-Norfolk	202.0	6.4	59.6	0.5	268.4
Hamilton	39.7	1.5	16.7	-	58.0
Lambton	357.3	0.8	25.3	-	383.6
Middlesex	327.3	4.3	31.8	-	363.5
Niagara	85.5	8.7	228.3	3.0	325.5
Oxford	251.9	1.9	17.3	-	271.2
<b>Southern Ontario</b>	<b>2,001.9</b>	<b>41.1</b>	<b>506.5</b>	<b>4.6</b>	<b>2,554.1</b>
Bruce	199.1	0.6	13.6	-	213.2
Dufferin	34.5	0.3	3.4	-	38.2
Grey	83.2	1.4	38.5	0.4	123.5
Halton	9.6	0.4	6.2	-	16.2
Huron	414.0	1.5	21.6	-	437.2
Peel	27.9	0.3	5.5	-	33.8
Perth	217.3	0.7	13.7	-	231.7
Simcoe	143.2	2.5	21.4	-	167.2
Waterloo	87.0	0.5	7.5	-	95.0
Wellington	191.2	0.5	13.9	-	205.7
<b>Western Ontario</b>	<b>1,407.0</b>	<b>8.5</b>	<b>145.2</b>	<b>0.7</b>	<b>1,561.5</b>
Durham	101.4	1.0	17.7	-	120.3
Hastings	33.5	0.2	4.1	-	37.8
Kawartha Lakes	63.7	0.4	5.2	-	69.3
Muskoka	0.2	-	0.8	-	1.1
Northumberland	86.3	0.5	13.0	-	100.0
Parry Sound	2.6	-	0.7	-	3.4
Peterborough	29.1	-	3.8	-	33.0
Prince Edward	36.8	0.6	10.4	-	47.9
York	67.3	3.3	14.5	-	85.2
<b>Central Ontario</b>	<b>421.8</b>	<b>6.3</b>	<b>70.4</b>	<b>0.5</b>	<b>499.0</b>
Frontenac	31.5	-	2.0	-	33.6
Lanark	30.8	-	2.7	-	33.6
Leeds and Grenville	60.9	-	4.8	-	65.9
Lennox and Addington	16.0	-	3.5	-	19.7
Ottawa	72.4	0.6	7.7	-	80.7
Prescott and Russell	200.7	0.3	8.4	-	209.4
Renfrew	49.8	-	4.4	-	54.5
Stormont, Dundas and Glengarry	179.5	0.3	10.7	-	190.5
<b>Eastern Ontario</b>	<b>641.8</b>	<b>1.8</b>	<b>44.2</b>	<b>0.2</b>	<b>688.1</b>
<b>Northern Ontario</b>	<b>35.8</b>	<b>0.5</b>	<b>9.9</b>	<b>-</b>	<b>46.2</b>
<b>Ontario</b>	<b>4,564.8</b>	<b>57.5</b>	<b>774.6</b>	<b>6.1</b>	<b>5,403.0</b>

- less than 200 kg

Note: Totals may not add due to rounding.

**Appendix VIII. Comparison of Total Active Ingredients Used on Major Crops and for Selected Pesticide Groupings, by Year**

Crop	Pesticide or Group	Active Ingredient Used (kg)						
		1983	1988	1993	1998	2003	2008	2013
Field corn	alachlor	614,680	940	-	-	-	-	-
	atrazine	1,719,840	999,410	585,208	573,721	499,253	448,071	293,208
	glyphosate	4,140	17,210	71,862	70,924	125,016	527,952	1,151,051
	metolachlor/s-metolachlor	491,020	712,170	897,870	773,833	313,934	356,748	547,774
	all herbicides	3,653,310	2,491,370	2,351,146	1,982,949	1,525,659	1,564,362	2,125,918
Soybeans	alachlor	436,800	1,190	-	-	-	-	-
	metolachlor/s-metolachlor	325,450	915,170	391,152	552,963	190,301	82,760	187,581
	glyphosate	28,450	41,770	164,784	375,109	861,983	1,253,773	1,544,954
	all herbicides	1,281,880	1,694,770	1,133,103	1,274,624	1,196,055	1,445,945	1,883,711
Grains	all herbicides	376,140	491,320	443,620	356,641	407,125	497,721	315,819
Total field crops	all herbicides	5,411,260	4,984,560	4,143,523	3,763,481	3,225,735	3,659,447	4,470,072
	all pesticides	7,800,480	6,206,580	5,211,758	4,293,051	3,729,341	3,935,275	4,690,592
Total fruit	all fungicides	410,990	429,610	457,509	459,197	209,592	458,257	454,023
	all pesticides	562,640	598,560	628,111	543,061	248,732	532,794	502,515
Total vegetables	all pesticides	356,120	396,330	406,573	331,363	204,416	337,629	209,930
Total field crops, fruit & vegetables	all pesticides	8,719,240	7,201,470	6,246,442	5,167,475	4,182,489	4,805,698	5,403,037

**Appendix IX. Comparison of Total Active Ingredients Used per Hectare on Major Crops and for Selected Pesticide Groupings, by Year**

Crop	Pesticide or Group	Active Ingredient Used per Area Grown (kg/ha)						
		1983	1988	1993	1998	2003	2008	2013
Field corn	all herbicides	3.47	2.90	2.90	2.28	1.77	1.90	2.11
Soybeans	all herbicides	3.52	3.27	1.65	1.50	1.48	1.70	1.79
Grains	all herbicides	0.44	0.58	0.72	0.56	0.58	0.69	0.55
Total field crops	all herbicides	1.33	1.31	1.13	1.01	0.86	0.96	1.18
	all pesticides	1.92	1.63	1.42	1.15	1.00	1.03	1.23
Total fruit	all fungicides	14.47	14.81	15.10	17.20	8.32	20.83	25.19
	all pesticides	19.81	20.64	20.73	20.34	9.87	24.22	27.88
Total vegetables		4.89	6.01	5.91	4.72	2.65	5.40	3.59
Total field crops, fruit & vegetables	all pesticides	2.10	1.85	1.66	1.35	1.09	1.23	1.39

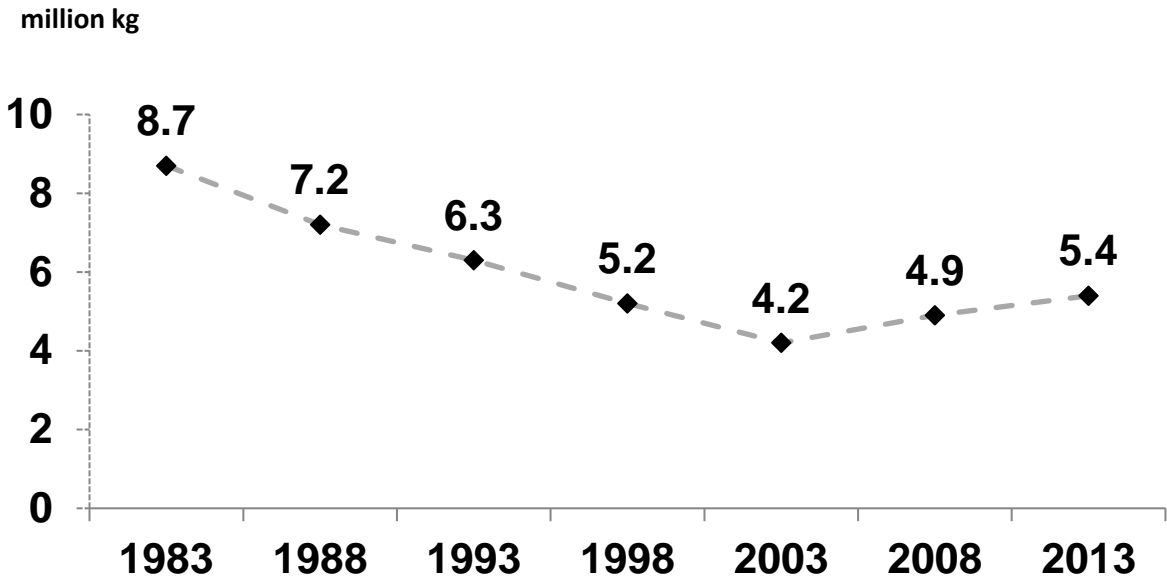
## Appendix X. Herbicide Usage on Field Corn, Soybeans and Wheat per Unit of Production, by Year

		1983	1988	1993	1998	2003	2008	2013/14
<b>Corn</b>	Total kg ai	3,653,310	2,491,370	2,351,146	1,982,949	1,525,659	1,564,362	2,125,918
	Acreage*	2,000,000	1,740,000	1,750,000	1,840,000	1,725,000	1,730,000	2,210,000
	kg ai/acre	1.83	1.43	1.34	1.08	0.88	0.90	0.96
	Yield (bu/ac)	92.50	84.50	108.60	128.80	127.00	156.10	160.50
	<b>kg ai/1000 bu</b>	<b>19.75</b>	<b>16.94</b>	<b>12.37</b>	<b>8.37</b>	<b>6.96</b>	<b>5.79</b>	<b>5.99</b>
	3 yr avg yield (bu/ac)**	95.83	102.10	108.80	123.17	123.80	144.27	158.20
	<b>kg ai/1000 bu</b>	<b>19.06</b>	<b>14.02</b>	<b>12.35</b>	<b>8.75</b>	<b>7.14</b>	<b>6.27</b>	<b>6.08</b>
<b>Soybeans</b>	Total kg ai	1,281,880	1,694,770	1,133,103	1,274,624	1,196,055	1,445,945	1,883,711
	Acreage*	900,000	1,280,000	1,740,000	2,100,000	1,990,000	2,095,000	2,595,000
	kg ai/acre	1.42	1.32	0.65	0.61	0.60	0.69	0.73
	Yield (bu/ac)	30.00	32.30	38.50	41.00	31.90	43.40	45.90
	<b>kg ai/1000 bu</b>	<b>47.48</b>	<b>40.99</b>	<b>16.91</b>	<b>14.80</b>	<b>18.84</b>	<b>15.90</b>	<b>15.81</b>
	3 yr avg yield (bu/ac)**	32.80	35.63	37.83	39.83	35.13	38.87	46.57
	<b>kg ai/1000 bu</b>	<b>43.42</b>	<b>37.16</b>	<b>17.21</b>	<b>15.24</b>	<b>17.11</b>	<b>17.76</b>	<b>15.59</b>
<b>Wheat</b>	Total kg ai				155,962	235,436	395,901	247,224
	Acreage*				710,000	990,000	1,225,000	1,045,000
	kg ai/acre				0.22	0.24	0.32	0.24
	Yield (bu/ac)				62.70	76.30	80.20	80.10
	<b>kg ai/1000 bu</b>				<b>3.50</b>	<b>3.12</b>	<b>4.03</b>	<b>2.95</b>
	3 yr avg yield (bu/ac)**				65.67	73.60	75.63	78.57
	<b>kg ai/1000 bu</b>				<b>3.34</b>	<b>3.23</b>	<b>4.27</b>	<b>3.01</b>

\*Acreage is based on 2013 data.

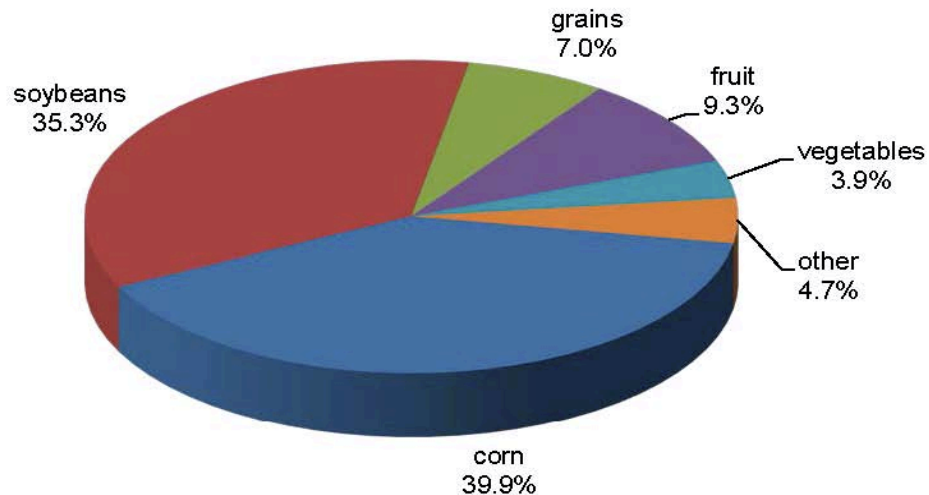
\*\*The 3 year average yield is based on the bushels per acre (bu/ac) for the survey year, the year prior and the year after.

**Figure 1: Quantities of pesticide active ingredients used on all crops in Ontario, 1983 to 2013/14**

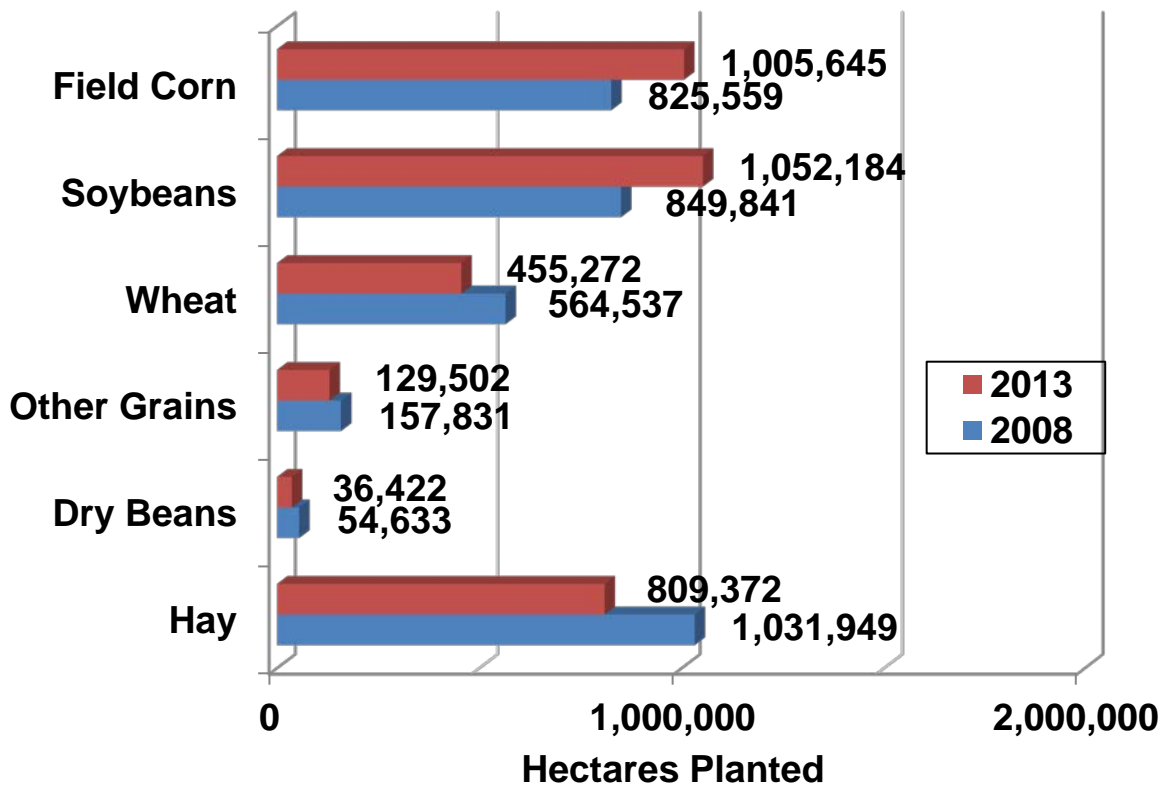


**Figure 2: Pesticide active ingredients used in Ontario by crop, 2013**

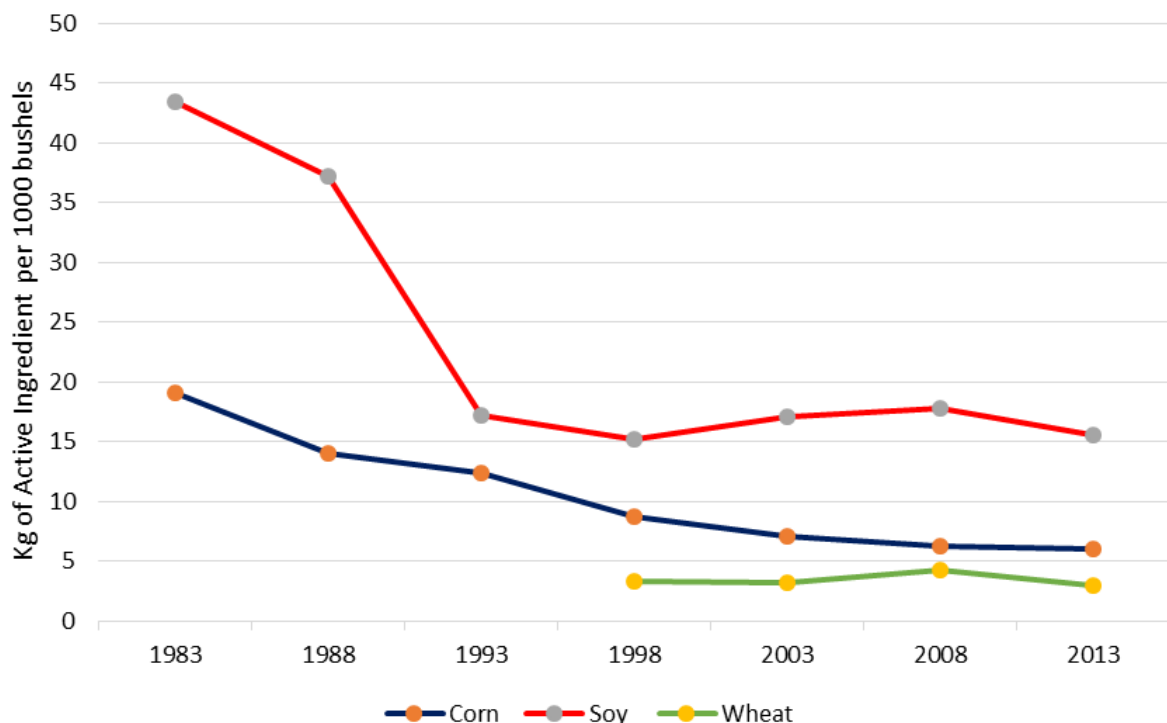
(total = 5.40 million kg)



**Figure 3: Field Crop Acreage Amounts in Ontario, 2013 and 2008 (hectares)**



**Figure 4: Herbicide usage on select crops in Ontario, 1983 to 2013/14**



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