

ECONOMICS INFORMATION

SURVEY OF PESTICIDE USE IN ONTARIO, 2003
Estimates of Pesticides Used on Field Crops, Fruit
and Vegetable Crops, and Other Agricultural Crops

by

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INTRODUCTION

Organic pesticides have been used in Ontario since the end of the second World War. The concern expressed by many groups regarding the contamination of fish and wildlife resulted in the need to identify and quantify the pesticides used in the Great Lakes Watershed.

Canada and the United States signed the *Great Lakes Water Quality Agreement* in 1972. The International Joint Commission (IJC), acting for the two governments, oversees all activities in pursuance of this Agreement. As part of the Water Quality Agreement, the IJC established the Pollution from Land Use Activities Reference Group (PLUARG) to determine sources, quantify inputs, and assess the impact of inputs from a variety of land use activities on water quality. These activities include those involved with agriculture as well as forestry, city and urban areas, highways, and other industries. Documentation of the volume of each pesticide used in Ontario at sub-provincial levels was essential to these studies.

The PLUARG group requested in 1972 that a survey of pesticide use be carried out every five years in the province to identify and quantify the pesticides used in the Great Lakes Watershed. The data collected would be useful in estimating pesticide use in pursuance of the IJC Agreement; detecting trends in pesticide use by crop and by region in Ontario; and gauging the local and overall effectiveness of this Ministry's work in pest and weed control.

Since 1973, surveys of **agricultural** pesticide use have been carried out every five years by the Ontario Ministry of Agriculture and Food (OMAF). The statistical aspects of these surveys have been handled primarily by the Statistical Services Unit of OMAF's Policy and Programs Branch. The results appeared in *Survey of Pesticide Use in Ontario, 1973* [1], *1978* [2], *1983* [3], *1988* [4], *1993* [5] and *1998* [6]. 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 in agricultural crops.

As was the case in 1998, the 2003 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 have not been included on this survey occasion.

SURVEY OF PESTICIDE USE ON AGRICULTURAL CROPS

Sample Selection and Editing

In Ontario, growers must comply with training requirements relating to pesticide use in order to purchase and apply pesticides to their crops. The list of certified producers is maintained at the Ridgetown College, University of Guelph.

This list was used as the sampling frame for the 2003 version of the Pesticide Use Survey. The sample of farms to be randomly selected from the list was designed to ensure sufficient coverage on a crop by crop basis, as well as to be representative geographically.

The selected farmers received Pesticide Use Record Forms in the spring of 2003. They were requested to maintain these forms during the crop growing season by noting spraying details such as crops treated, chemical products and concentrations used, application rates, area grown, area sprayed, and dates of application. Respondents were asked to return the forms to Ridgetown College in the fall for manual editing and data entry.

Over 1,300 forms were returned with useful information. No names, addresses, telephone numbers or other personal identifiers accompanied these forms - in fact, the only geographic identifier was the county number. Each questionnaire was checked for consistency and completeness, and, as much as possible, appropriate adjustments were made for missing data.

Data processing, statistical analysis and tabulation of results were responsibilities of the Statistical Services Unit, Policy and Programs Branch, Ontario Ministry of Agriculture and Food (OMAF). Quantities of active ingredients for each chemical were computed by multiplying area sprayed times concentration times application rate. To help ensure the plausibility of the results of these calculations, pesticide specialists with OMAF's Agriculture and Rural Division scrutinized the estimates of active ingredient usage and reviewed application rates at various stages during the preparation of this report.

Expanding the Sample Data

In order to estimate total pesticide usage on all farms, it is necessary to boost the sample results by calculating appropriate expansion factors. The expansion factor for each crop is unique. These factors are calculated as the ratio of the total provincial area of a particular crop to the area of that same crop reported in the questionnaires returned. Please refer to Appendix I for a detailed example of this calculation.

Pesticide quantities used at the county level were derived by employing proportional area breakdowns once the estimation of the active ingredients of each specific pesticide by crop at the provincial level was complete. This method of allocation was used in order to avoid distortions due to low sample sizes in some counties. More stable results are obtained by first calculating a reliable provincial level estimate of pesticide use and then allocating to counties on the basis of area grown.

The assumption here is that crops are chemically treated in a somewhat similar fashion regardless of their location in the province.

The sample occasionally had limitations in that certain specific pesticides or crops were not adequately represented and hence, pesticide use in such instances could not be estimated. The use of a given pesticide may appear to be zero when, in reality, it is likely to have been applied. There are two main reasons for this result:

- (a) the use of such pesticides was not detected in the sample; or
- (b) the area grown to a particular crop, while existent, was still too small to be estimable in a county - hence, no expansion factor could be computed.

In addition, it should be noted that some chemicals which are no longer licensed may still be reported as stocks in storage diminish.

Additional Notes

As with recent versions of this survey, the scope of the 2003 Survey of Pesticide Use provides a measure of the agricultural use of pesticides on field crops as well as on field grown fruit and vegetable crops. The 2003 survey also includes estimates of pesticide use on nursery crops, sod and ginseng (Appendix V).

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

SUMMARY OF RESULTS

Presentation

The results of the 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 VII lists the common names reported in the survey.

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

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

Appendices IX and X compare some 2003 pesticide use information highlighted for selected crops and selected pesticides with the results from previous surveys held in 1983, 1988, 1993 and 1998.

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 appear to add due to rounding.

Highlights

The report shows that agricultural pesticide use continues to decline as measured by total active ingredient (a.i.). The overall decrease from 1983 to 1993 was 8,700 tonnes a.i. to 6,200 tonnes a.i. This declined further in 1998 to 5,200 tonnes a.i. Between 1998 and 2003 a further reduction occurred to 4,200 tonnes a.i. Over the last 20 years there has been a 52 percent reduction in total pesticide usage.

Atrazine use in field corn was maintained at 80 percent of the 1998 usage, at 499,000 kg. This demonstrates that atrazine continues to be a required weed management tool in field corn.

Glyphosate use continues to increase in several crops. Total usage was 1,171,000 kg, which has increased by 58 percent since 1998. This large increase is primarily due to the adoption of glyphosate resistant soybean technology.

Metolachlor / s-metolachlor use declined by 61 percent. The greatest decline occurred in soybeans (66 percent), largely due to the aforementioned increase adoption of glyphosate resistant soybean technology.

The 14 percent increase in herbicides used on grains compared to 1998 is primarily a reflection of the record area grown to winter wheat in the province in 2003. Nematicide use in tobacco increased due to changes in product availability and formulations.

Overall pesticide use in fruit and vegetable crops decreased by 20 percent since 1998, with the largest decline occurring with insecticides in fruit (57 percent), followed by fungicides in both fruit (54 percent) and vegetables (54 percent). There are several reasons for these large declines: significant decrease in apple acreage, an increased adoption of integrated pest management (IPM) and alternative pest control strategies, such as; border sprays for migratory pests, mating disruption, alternate row spraying and pest monitoring. Each of these IPM / alternative strategies significantly reduce pesticide use.

Broad-spectrum pest control products are being replaced by more target specific technology, with low amounts of a.i. used per acre. Producers are utilizing every mitigation strategy possible to control pests in an environmentally and economically sustainable way. Society and low profit margins demand it.

Pesticide use in 2003 demonstrated the continued decline in use that was documented in the 1998 survey. The decline continues at the same rate of 1,000 tonnes that was observed from 1993 to 1998.

APPENDICES

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

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 2003 2,000,000 acres

Total area of soybeans reported in survey 93,500 acres

Therefore, the expansion factor for soybeans is: $2,000,000 / 93,500 = 21.39$

For each record in the sample, the quantity of active ingredient of all chemicals 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 metolachlor used on soybeans in the province

Total quantity of active ingredient of metolachlor used on soybeans in the sample was 5,217.6 kg.

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

$$5,217.6 \times 21.39 = 111,604 \text{ kg}$$

(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 metolachlor used on soybeans in Lambton County

The area grown to soybeans in Lambton County accounts for 12.4% of the provincial total.

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

$$0.124 \times 111,604 = 13,839 \text{ kg}$$

(This represents the share that metolachlor use on soybeans contributes to the Lambton County estimate for “other herbicides” which appears in Appendix VIII.)

Appendix II - Quantities of Specific Pesticide Active Ingredients Used on Field Crops in Ontario, 2003

Pesticide by Crop	Quantity	Pesticide by Crop	Quantity	Pesticide by Crop	Quantity
Herbicides	kg	Herbicides (continued)	kg	Herbicides (continued)	kg
soybeans		winter wheat		canola	
2,4-D amines	3,527	2,4-D amines	39,997	clopyralid	217
2,4-DB (butyl ester)	219	2,4-DB (butyl ester)	1,677	glyphosate	9,067
aciflurofen	262	amitrole	661	trifluralin	1,027
amitrole	3,364	ammonium sulfamate	1,139	other	267
ammonium sulfamate	5,968	bentazon	439	total	10,578
bentazon	39,714	bromoxynil	46,832	white beans	
bromoxynil	774	dicamba	509	2,4-D amines	617
dimethenamid	6,345	dichlorprop	8,577	ammonium sulfamate	3,207
fenoxaprop-ethyl	1,215	glyphosate	71,729	bensulide	330
fluzifop-butyl	1,690	imazethapyr	327	bentazon	2,371
flufenacet	3,859	MCPA/MCPB	62,663	dimethenamid	1,162
flumetsulam	19,371	thifensulfuron-methyl	452	diquat	264
fomesafen	1,261	other	435	fomesafen	1,050
glufosinate ammonium	3,469	Total	235,436	glyphosate	13,517
glyphosate	861,983	spring wheat		imazethapyr	852
imazethapyr	14,501	2,4-D amines	2,225	metolachlor	791
linuron	3,769	2,4-DB (butyl ester)	769	s-metolachlor	717
MCPA/MCPB	691	bromoxynil	7,612	trifluralin	8,234
metolachlor	111,604	dichlorprop	246	other	38
metribuzin	29,008	glyphosate	2,252	total	33,150
pendimethalin	791	MCPA/MCPB	12,715	other dry beans	
quizalofop-ethyl	333	other	264	2,4-D amines	258
related triazines	1,937	total	26,082	bentazon	2,866
s-metolachlor	78,697	oats		diquat	591
trifluralin	912	2,4-D amines	4,027	fomesafen	766
other	790	2,4-DB (butyl ester)	5,185	glyphosate	10,595
Total	1,196,055	bromoxynil	2,797	imazethapyr	322
field corn		glyphosate	2,104	s-metolachlor	2,890
2,4-D amines	10,521	MCPA/MCPB	10,387	trifluralin	3,707
2,4-DB (butyl ester)	1,410	other	125	other	18
ammonium sulfamate	916	total	24,625	total	22,014
atrazine	499,253	barley		tobacco	
bentazon	10,347	2,4-D amines	9,125	glyphosate	222
bromoxynil	8,774	2,4-DB (butyl ester)	8,961	napropamide	1,662
clopyralid	3,276	bromoxynil	9,371	other	235
cyanazine	443	dichlorprop	248	total	2,120
dicamba	194,165	glyphosate	14,422	hay	
diflufenzopyr	6,996	MCPA/MCPB	26,734	2,4-D amines	544
dimethenamid	197,647	other	291	2,4-DB (butyl ester)	2,153
EPTC/R25788	1,945	total	69,153	glyphosate	15,370
flufenacet	4,173	mixed grains		MCPA/MCPB	321
flumetsulam	3,338	2,4-D amines	6,420	total	18,387
glufosinate ammonium	9,977	2,4-DB (butyl ester)	7,689	pasture	
glyphosate	125,016	bromoxynil	2,163	2,4-D amines	602
imazethapyr	519	glyphosate	9,438	glyphosate	1,618
isoxaflutole	2,565	MCPA/MCPB	10,749	other	167
linuron	1,299	other	413	total	2,388
MCPA/MCPB	2,140	total	36,873	flaxseed	
metolachlor	124,089	rye		atrazine	758
metribuzin	1,941	2,4-D amines	7,946	dicamba	391
nicosulfuron	8,888	bromoxynil	1,346	s-metolachlor	1,084
pendimethalin	83,913	glyphosate	2,907	other	38
primisulfuron-methyl	285	MCPA/MCPB	2,281	total	2,271
prosulfuron	2,567	other	475	other field crops	
related triazines	23,067	total	14,956	glyphosate	5,275
rimsulfuron	5,922	total		other	715
s-metolachlor	189,845	total		total	5,989
other	423	total		Total Herbicides	3,225,735
Total	1,525,659				

Appendix II - Quantities of Specific Pesticide Active Ingredients Used on Field Crops in Ontario, 2003 (continued)

Pesticide by Crop	Quantity	Pesticide by Crop	Quantity	Pesticide by Crop	Quantity
Insecticides	kg	Fungicides	kg	Nematocides	kg
winter wheat		winter wheat		tobacco	
trichlorfon	221	propiconazole	1,842	1,3 dichloropropene	239,057
other	178	tebuconazole	5,628	chloropicrin	81,847
total	400	total	7,470	dichloropropene	7,592
mixed grain		oats		metam-sodium	382
dimethoate	526	propiconazole	491	methyl isothiocyanate	2,317
other	59	total	491	total	331,195
total	585	soybeans		Total Nematocides	331,195
soybeans		captan	289	Growth Regulators	
other	637	other	17	field corn	
total	637	total	306	tallow fatty acid	499
field corn		field corn		total	499
carbofuran	860	antimycin	440	tobacco	
cypermethrin	1,188	other	158	fatty alcohol-entrol	5,136
tefluthrin	2,536	total	598	fatty alcohol - N-decanol	133,856
other	381	canola		total	138,992
total	4,964	vinclozolin	274	Total Growth Regulators	139,491
white beans		total	274	Total All Pesticides	3,729,341
dimethoate	3,188	white beans			
total	3,188	vinclozolin	550		
other dry beans		total	550		
dimethoate	1,273	tobacco			
other	2	chlorothalonil	2,203		
total	1,275	metalaxyl	276		
tobacco		other	90		
acephate	7,780	total	2,569		
chlorpyrifos	1,026	other field crops	262		
pirimicarb	278	Total Fungicides	12,520		
other	241				
total	9,325				
other field crops	26				
Total Insecticides	20,400				

**Appendix III - Quantities of Specific Pesticide Active Ingredients Used on All Fruit
in Ontario, 2003**

Pesticide Used	Quantity	Pesticide Used	Quantity
	kilograms		kilograms
HERBICIDES		INSECTICIDES	
chlorthal dimethyl	453	azinphos-methyl	7,692
dichlobenil	402	carbaryl	2,773
diuron	299	chlorpyrifos	2,718
glyphosate	3,732	cypermethrin	244
napropamide	732	diazinon	1,883
paraquat	811	dinocap	2,605
simazine	1,023	endosulfan	215
terbacil	609	phosalone	1,801
other	429	phosmet	8,658
Total	8,491	pyridaben	593
		other	1,108
		Total	30,291
FUNGICIDES		NEMATOCIDES	
captan	60,337		
chlorothalonil	901	Total	59
copper oxychloride	6,318		
copper sulfate	922	GROWTH REGULATORS	
dodine	539	ethephon	246
fenbuconazole	217	other	53
fenhexamid	275	Total	299
ferbam	1,769		
ferric dimethyidithiocarbamate	1,944	GRAND TOTAL	
folpet	3,280		248,732
fosetyl-al	610		
iprodione	1,903		
kresoxim-methyl	652		
mancozeb	40,681		
metiram	33,848		
myclobutanil	704		
sulphur	54,080		
other	611		
Total	209,592		

**Appendix IV - Quantities of Specific Pesticide Active Ingredients Used on All Vegetables
in Ontario, 2003**

Pesticide Used	Quantity	Pesticide Used	Quantity
	kilograms		kilograms
INSECTICIDES		HERBICIDES	
acephate	1,612	2,4-D amines	1,095
azinphos-methyl	2,213	atrazine	13,868
<u>Bacillus thuringiensis</u>	6,140	bentazon	3,530
carbaryl	2,009	bromoxynil	943
carbofuran	849	clomazone	909
chlorpyrifos	1,621	diquat	1,137
cypermethrin	363	glyphosate	8,295
diazinon	1,983	imazethapyr	818
dimethoate	1,407	linuron	12,567
endosulfan	3,376	MCPA/MCPB	398
imidaclorpid	290	metolachlor	19,204
malathion	1,349	metribuzin	6,012
methamidophos	981	napropamide	392
methomyl	558	nicosulfuron	9,431
naled	315	paraquat	460
permethrin	249	pendimethalin	629
phosmet	3,705	prometryne	1,916
terbufos	1,729	pyrazon	608
other	339	rimsulfuron	290
Total	31,084	simazine	517
		s-metolachlor	13,558
		trifluralin	2,900
		other	782
		Total	100,259
FUNGICIDES		GROWTH REGULATORS	
captan	707	ethephon	2,622
chlorothalonil	32,871	Total	2,622
copper hydroxide	8,351		
flusilazole	1,103		
fosetyl-al	1,065		
iprodione	345		
mancozeb	19,496		
metalaxyl	700		
metallic copper	5,058		
metiram	263	GRAND TOTAL	204,416
pyraclostrobin	204		
other	288		
Total	70,451		

**Appendix V - Quantities of Specific Pesticide Active Ingredients Used on Other
Agricultural Crops* in Ontario, 2003**

Pesticide Used	Quantity	Pesticide Used	Quantity
	kilograms		kilograms
HERBICIDES		FUNGICIDES	
2,4-D amines	201	chlorothalonil	2,581
glyphosate	13,219	fosetyl-al	3,699
other	213	iprodione	707
Total	13,633	mancozeb	4,469
		metalaxyl	9,889
		other	5
NEMATOCIDES		Total	21,350
1,3 dichloropropene	766		
Total	766	GRAND TOTAL	35,749

* Other crops include nursery crops, sod and ginseng. Greenhouse crops are not included in the survey.

Appendix VI - Quantities of Active Ingredients of Each Type of Pesticide Used on All Surveyed Crops in Ontario, 2003

Crop	Herbicides				Insecticides	Fungicides	Nematocides	Growth Regulators	Total Pesticides	Percentage of Usage by Crop %
	Triazine	Phenoxy	Other	Total						
	- tonnes -									
Field Corn	524.7	208.3	792.7	1,525.7	5.0	0.6	-	0.5	1,531.7	36.3
Soybeans	30.9	4.5	1,160.6	1,196.1	0.6	0.3	-	-	1,197.0	28.4
Dry Beans	-	0.9	54.3	55.2	4.5	0.6	-	-	60.3	1.4
Tobacco	-	0.1	2.0	2.1	9.3	2.6	331.2	139.0	484.2	11.5
Grains ^a	-	221.1	186.0	407.1	1.0	8.1	-	-	416.3	9.9
Canola	-	-	10.6	10.6	-	0.3	-	-	10.9	0.3
Hay and Pasture	-	3.7	17.1	20.8	-	-	-	-	20.8	0.5
Other Field Crops	0.9	0.7	6.7	8.3	-	-	-	-	8.3	0.2
Field Crops	556.5	439.3	2,229.9	3,225.7	20.4	12.5	331.2	139.5	3,729.3	88.4
Fruit	1.0	0.1	7.3	8.5	30.3	209.6	0.1	0.3	248.7	5.9
Vegetables	22.5	1.5	76.3	100.3	31.1	70.5	-	2.6	204.4	4.8
Other Crops	-	0.3	13.3	13.6	-	21.3	0.8	-	35.7	0.8
All Surveyed Crops	580.1	441.2	2,326.9	3,348.1	81.8	313.9	332.0	142.4	4,218.2	100.0
% of Usage by Pesticide Grouping	13.8	10.5	55.2	79.4	1.9	7.4	7.9	3.4	100.0	

a Includes wheat, oats, barley, mixed grain and rye.

Note: Totals may not add due to rounding.

Appendix VII - Quantities of Specific Pesticide Active Ingredients Used on All Surveyed Crops in Ontario, 2003

Pesticide Used	Quantity	Pesticide Used	Quantity	Pesticide Used	Quantity
Herbicides	kg	Insecticides	kg	Fungicides	kg
2,4-D amines (p)	87,261	acephate	9,402	antimycin	440
2,4-DB (butyl ester) (p)	28,256	azinphos-methyl	9,905	captan	61,422
acifluofen (o)	262	<u>Bacillus thuringiensis</u>	6,140	chlorothalonil	38,570
amitrole (o)	4,169	carbaryl	4,851	copper hydroxide	8,371
ammonium sulfamate (o)	11,230	carbofuran	1,778	copper oxychloride	6,318
atrazine (t)	513,950	chlorpyrifos	5,366	copper sulfate	922
bensulide (o)	330	cyhalothrin-lambda	271	dodine	577
bentazon (o)	59,300	cypermethrin	1,810	fenbuconazole	217
bromoxynil (o)	80,871	diazinon	3,970	fenhexamid	290
chlorthal dimethyl (o)	453	dimethoate	6,588	ferbam	1,898
clomazone (o)	1,029	dinocap	2,627	ferric dimethyldithiocarbamate	1,944
clpyralid (o)	3,641	endosulfan	3,698	flusilazole	1,187
cyanazine (t)	443	imidacloprid	527	folpet	3,280
dicamba (p)	195,627	malathion	1,543	fosetyl-al	5,373
dichlobenil (o)	402	methamidophos	981	iprodione	2,956
dichlorprop (o)	9,459	methomyl	558	kresoxim-methyl	652
diflufenzopyr (o)	6,996	naled	315	mancozeb	64,647
dimethenamid (o)	205,291	parathion	211	metalaxyl	10,891
diquat (o)	2,107	permethrin	647	metallic copper	5,058
diuron (o)	299	phosalone	1,801	metiram	34,111
EPTC/R25788 (o)	1,945	phosmet	12,362	myclobutanil	740
fenoxaprop-ethyl (o)	1,215	pirimicarb	642	propiconazole	2,648
fluazifop-butyl (o)	1,932	pyridaben	593	pyraclostrobin	204
flufenacet (o)	8,032	tefluthrin	2,583	sulphur	54,106
flumetsulam (o)	22,807	terbufos	1,729	tebuconazole	5,788
fomesafen (o)	3,077	trichlorfon	221	vinclozolin	899
glufosinate ammonium (o)	13,602	other	655	other	405
glyphosate (o)	1,170,762	Total	81,775	Total	313,912
imazethapyr (o)	17,338	Nematocides		Growth Regulators	
isoxaflutole (o)	2,565	1,3 dichloropropene	239,824	ethephon	2,868
linuron (o)	17,634	chloropicrin	81,847	fatty alcohol - N-decanol	133,856
MCPA/MCPB (p)	129,337	dichloropropene	7,592	fatty alcohol-emptrol	5,136
mecoprop salts, acids (p)	703	metam-sodium	441	tallow fatty acid	499
metolachlor (o)	255,705	methyl isothiocyanate	2,317	other	53
metribuzin (t)	36,966	Total	332,021	Total	142,412
napropamide (o)	2,786			Total All Pesticides	4,218,238
nicosulfuron (o)	18,360				
paraquat (o)	1,271				
pendimethalin (o)	85,334				
primisulfuron-methyl (o)	285				
prometryne (t)	1,916				
prosulfuron (o)	2,567				
pyrazon (o)	764				
quizalofop-ethyl (o)	371				
related triazines (t)	25,241				
rimsulfuron (o)	6,212				
sethoxydim (o)	335				
simazine (t)	1,540				
s-metolachlor (o)	286,923				
terbacil (o)	609				
thifensulfuron-methyl (o)	613				
tralkoxydim (o)	323				
trifluralin (o)	16,889				
other	778				
Total	3,348,118				

(t) triazine herbicide
 (p) phenoxy herbicide
 (o) other herbicide

**Appendix VIII - Quantities of Active Ingredients of Each Type of Pesticide Used on All Surveyed Crops in 2003,
by Region and County, Ontario**

	Herbicides				Insecticides	Fungicides	Nematocides	Growth Regulators	Total Pesticides
	Triazine	Phenoxy	Other	Total					
	- kilograms -								
Hamilton	6,789	4,701	28,467	39,958	2,334	9,008	4	37	51,340
Niagara	8,985	6,737	47,379	63,102	12,744	124,020	2	160	200,029
Haldimand-Norfolk	21,935	20,047	108,823	150,805	11,906	34,584	185,264	77,795	460,355
Brant	10,489	7,388	35,998	53,875	2,394	8,671	32,892	13,785	111,617
Oxford	39,160	22,435	113,938	175,533	3,361	6,336	33,796	14,194	233,220
Elgin	28,142	15,974	110,873	154,989	4,143	7,358	48,953	20,597	236,040
Chatham-Kent	44,474	26,390	208,326	279,189	4,092	20,009	13,736	7,300	324,325
Essex	20,540	11,914	133,478	165,932	4,412	22,316	545	976	194,182
Lambton	30,303	26,064	207,267	263,633	2,339	6,007	1,161	545	273,686
Middlesex	46,807	28,590	184,556	259,954	3,383	5,972	14,157	5,980	289,446
Southern Ontario	257,625	170,241	1,179,105	1,606,970	51,109	244,282	330,511	141,369	2,374,241
Peel	4,597	4,196	17,987	26,781	484	1,192	2	9	28,466
Dufferin	3,645	6,362	20,942	30,949	1,294	2,218	2	3	34,466
Wellington	22,731	22,413	86,411	131,555	768	1,199	2	22	133,545
Halton	4,480	4,172	20,186	28,838	581	2,000	3	12	31,434
Waterloo	15,698	11,543	43,139	70,380	620	1,096	1	17	72,115
Perth	38,073	26,395	130,240	194,708	1,747	1,066	1	35	197,556
Huron	49,787	35,938	194,793	280,517	3,566	2,773	1	46	286,904
Bruce	20,387	18,630	79,364	118,381	995	927	1	19	120,323
Grey	8,039	13,429	32,322	53,790	3,783	14,110	3	21	71,706
Simcoe	19,290	17,675	81,716	118,681	6,130	14,024	490	227	139,552
Western Ontario	186,727	160,754	707,099	1,054,580	19,967	40,603	505	412	1,116,067
Hastings	5,810	5,122	16,572	27,505	492	1,547	1	10	29,555
Prince Edward	4,685	4,048	19,133	27,866	619	2,058	1	10	30,553
Northumberland	9,863	8,121	33,794	51,778	1,142	3,657	487	222	57,287
Peterborough	4,204	4,703	14,241	23,149	156	353	3	6	23,666
Kawartha Lakes	6,194	6,925	24,070	37,189	314	472	1	8	37,983
Durham	14,557	11,062	49,717	75,336	1,864	5,207	488	230	83,125
York	8,699	5,943	34,488	49,130	3,138	9,452	3	46	61,769
Other	41	418	583	1,041	87	289	4	1	1,422
Central Ontario	54,054	46,342	192,599	292,995	7,812	23,034	988	532	325,361
Stormont, Dundas and Glengarry	31,421	16,562	86,233	134,216	755	1,301	1	36	136,310
Prescott and Russell	15,280	9,393	47,925	72,597	370	587	1	15	73,571
Ottawa	14,646	8,806	43,318	66,769	462	764	3	20	68,019
Leeds and Grenville	8,103	5,057	21,933	35,093	330	921	2	10	36,355
Lanark	2,616	2,507	7,852	12,974	77	234	2	3	13,290
Frontenac	1,874	1,665	5,460	8,999	62	121	0	3	9,185
Lennox and Addington	3,160	2,992	11,417	17,570	188	523	1	5	18,286
Renfrew	3,364	4,838	9,917	18,119	149	354	2	4	18,628
Eastern Ontario	80,463	51,820	234,054	366,337	2,393	4,805	13	96	373,644
Northern Ontario	1,207	12,027	14,001	27,235	494	1,188	4	3	28,924
Ontario	580,076	441,183	2,326,858	3,348,118	81,775	313,912	332,021	142,412	4,218,238

Note: Totals may not add due to rounding.

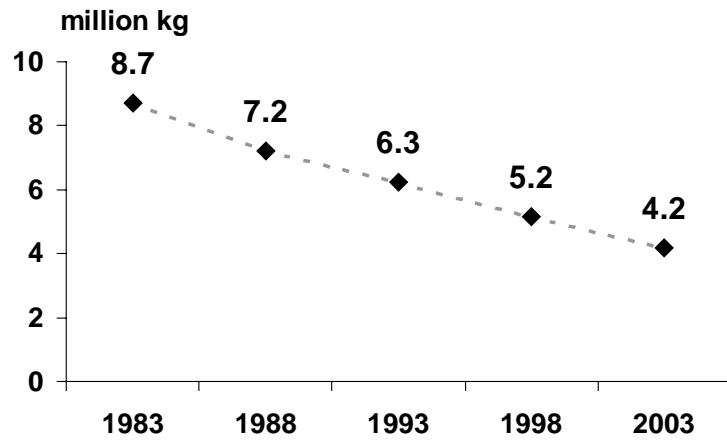
**Appendix IX - Comparison of Total Active Ingredients Used on Major Crops
and for Selected Pesticide Groupings, 1983, 1988, 1993, 1998 and 2003**

Crop	Pesticide or Group	Active Ingredient Used				
		1983	1988	1993	1998	2003
		- kilograms -				
field corn	alachlor	614,680	940	-	-	-
	atrazine	1,719,840	999,410	585,208	573,721	499,253
	metolachlor/s-metolachlor	491,020	712,170	897,870	773,833	313,934
	all herbicides	3,653,310	2,491,370	2,351,146	1,982,949	1,525,659
soybeans	alachlor	436,800	1,190	-	-	-
	metolachlor/s-metolachlor	325,450	915,170	391,152	552,963	190,301
	glyphosate	28,450	41,770	164,784	375,109	861,983
	all herbicides	1,281,880	1,694,770	1,133,103	1,274,624	1,196,055
grains	all herbicides	376,140	491,320	443,620	356,641	407,125
tobacco	all nematocides	1,610,610	766,810	537,118	262,429	331,195
total field crops	all herbicides	5,411,260	4,984,560	4,143,523	3,763,481	3,225,735
	all pesticides	7,800,480	6,206,580	5,211,758	4,293,051	3,729,341
total fruit	all fungicides	410,990	429,610	457,509	459,197	209,592
	all pesticides	562,640	598,560	628,111	543,061	248,732
total vegetables	all pesticides	356,120	396,330	406,573	331,363	204,416
total field crops, fruit & vegetables	all pesticides	8,719,240	7,201,470	6,246,442	5,167,475	4,182,489

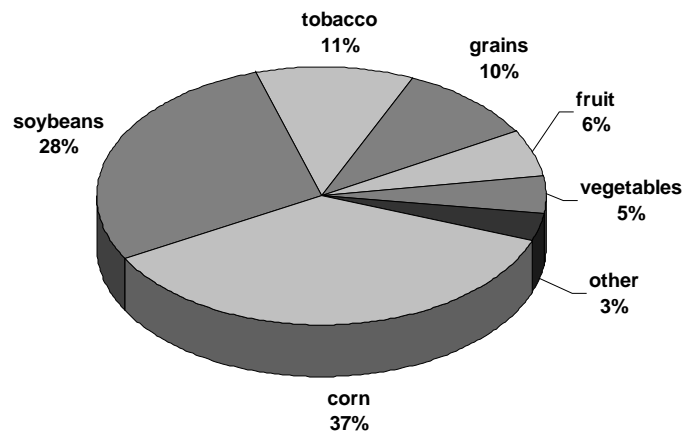
**Appendix X - Comparison of Total Active Ingredients Used per Hectare on Major Crops
and for Selected Pesticide Groupings, 1983, 1988, 1993, 1998 and 2003**

Crop	Pesticide or Group	Active Ingredient Used per Area Grown				
		1983	1988	1993	1998	2003
		- kg/ha -				
field corn	all herbicides	3.47	2.90	2.90	2.28	1.77
soybeans	all herbicides	3.52	3.27	1.65	1.50	1.48
grains	all herbicides	0.44	0.58	0.72	0.56	0.58
tobacco	all nematocides	39.77	31.56	18.78	9.65	19.14
total field crops	all herbicides	1.33	1.31	1.13	1.01	0.86
	all pesticides	1.92	1.63	1.42	1.15	1.00
total fruit	all fungicides	14.47	14.81	15.10	17.20	8.32
	all pesticides	19.81	20.64	20.73	20.34	9.87
total vegetables	all pesticides	4.89	6.01	5.91	4.72	2.65
total field crops, fruit & vegetables	all pesticides	2.10	1.85	1.66	1.35	1.09

Pesticide active ingredients used on all crops in Ontario, 1983 to 2003



Pesticide active ingredients used in Ontario, by crop, 2003 (total = 4.2 million kg)



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