

ECONOMICS INFORMATION

**SURVEY OF PESTICIDE USE IN ONTARIO, 1998
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, Food and Rural Affairs (OMAFRA) in consultation with personnel from the Ontario Ministry of the Environment (MOE), Agriculture and Agri-Food Canada, the University of Guelph, and the Canadian Agricultural Chemical Association. The technical aspects of these surveys have been handled primarily by the Statistical Services Unit of OMAFRA's Policy Analysis Branch. The results appeared in *Survey of Pesticide Use in Ontario, 1973* [1], *1978* [2], *1983* [3], *1988* [4] and *1993* [5]. These reports dealt with various aspects of pesticide use: field crops, fruit and vegetable crops, roadside spraying (except in 1988), and MOE licensed commercial applicators (in 1993).

The 1998 survey of pesticide use included field crops, fruit and vegetable crops, and 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 registered producers is maintained at the Ridgetown College of Agricultural Technology (RCAT).

This list was used as the sampling frame for the 1998 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 1998. 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. A summary questionnaire mailed to the same panel in the fall asked them to transfer the relevant information (i.e. the data required to calculate total amount of active ingredient used) and return the form to RCAT for manual editing and data entry.

About 1,200 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 Policy Analysis Branch, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). 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 the OMAFRA'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 field 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 1998 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. However, for the first time, the 1998 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 XII. Specific pesticides have been listed by their common names in the tables to avoid bias towards trade names. Appendix IX 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.

Tabulations of pesticide use on major fruit and vegetable crops (excluding greenhouse vegetables) are shown in Appendices VI and VII.

Total pesticide use on all surveyed crops is summarized in Appendix VIII (by crop or crop grouping), Appendix IX (by specific pesticide), and Appendix X (by county or district).

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

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.

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 1988 was from 8,700 tonnes A.I. to 7,200 tonnes. This declined further in 1993 to 6,200 tonnes. Between 1993 and 1998, a further reduction occurred to 5,200 tonnes.

Atrazine use on field corn remained fairly constant over the past 5 years at 574,000 kg. This demonstrates that the lowered use seen in 1993 has continued to fulfill a place in the weed management program for corn.

Glyphosate use went up in several crops. This reflects a continuing move as noted in 1993. Total usage was 647,000 kg in 1998, up 56 percent from 1993, and four-fold since 1988.

Metolachlor use was almost flat overall. On individual crops, however, usage was down in corn and up in soybeans.

For soybeans, herbicide use increased from 1.13 million kg to 1.27 million kg reflecting acreage changes. The mix of products used was relatively stable over the past 5 years.

It is significant to see the increase in use of newer herbicide families which have been recently registered. These products, which are used at grams per acre rates, are replacing products which were used at kilograms per acre rates.

Pesticide use in 1998 demonstrated the continued decline in use that was documented in the 1993 survey. It is clear from the 1998 survey that the decline continues at about the same rate as that from 1988 to 1993.

Pesticide use in fruit and vegetable crops was down in 1998, especially for insecticides. This in part reflects the control now attained for resistant pests like the Colorado potato beetle and Oriental fruit moth. Formerly, several successive applications of poorly effective products were used to attain some measure of control. New registrations during the past five years have gotten the pest population into check. With the low pest populations, only a few selective applications are needed. Effective controls, along with pest monitoring, could see such successes increase in future years.

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 apples

Total area of apples in 1998 28,500 acres

Total area of apples reported in survey 1,220 acres

Therefore, the expansion factor for apples is: $28,500 / 1,220 = 23.4$

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 fungicide use on apples

Total quantity of active ingredient of fungicides used on apples in the sample was 13,171 kg.

Therefore, the total quantity of active ingredient of fungicides used on apples would be:

$$13,171 \times 23.4 = 308,195 \text{ kg}$$

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

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 fungicide use on apples in Grey County

The area grown to apples in Grey County accounts for 22.0 percent of the provincial total.

Therefore, the total quantity of active ingredient of fungicides used on apples in Grey County would be:

$$0.220 \times 308,195 = 67,803 \text{ kg}$$

(This is the share that apples contribute to the Grey fungicide estimate appearing in Appendix X.)

Appendix II - Quantities of Specific Pesticide Active Ingredients Used on Field Crops in Ontario, 1998

Pesticide by Crop	Quantity	Pesticide by Crop	Quantity	Pesticide by Crop	Quantity
Herbicides	kg	Herbicides (continued)	kg	Herbicides (continued)	kg
field corn		white beans		winter wheat	
2,4-D amines	20,290	amitrole	331	2,4-D amines	26,676
2,4-DB (butyl ester)	479	bentazon	925	2,4-DB (butyl ester)	3,845
atrazine	573,721	dimethenamid	930	atrazine	389
bentazon	19,323	EPTC	489	bentazon	414
bromoxynil	18,506	EPTC/R25788	4,545	bromoxynil	22,816
butylate	7,508	ethalfluralin	1,033	dicamba	529
clopyralid	2,210	fomesafen	737	dichlorprop	1,642
cyanazine	47,460	glufosinate ammonium	599	glyphosate	52,586
dicamba	202,467	glyphosate	2,770	MCPA	15,933
dimethenamid	85,216	imazethapyr	470	MCPA/MCPB	27,362
EPTC	10,200	metobromuron	1,498	metolachlor	3,273
EPTC/R25788	26,034	pendimethalin	430	other	498
flumetsulam	820	trifluralin	2,280	total	155,962
glufosinate ammonium	976	other	177	oats	
glyphosate	70,924	total	17,211	2,4-D amines	1,708
imazethapyr	458	other dry beans		2,4-DB (butyl ester)	8,095
linuron	2,152	bentazon	1,452	bromoxynil	948
MCPA	243	dicamba	259	dicamba	413
MCPA/MCPB	885	fomesafen	445	glyphosate	1,776
mecoprop salts,acids	232	glyphosate	2,964	MCPA	4,670
metolachlor	773,833	imazethapyr	1,326	MCPA/MCPB	1,305
metribuzin	427	metobromuron	5,962	metribuzin	335
nicosulfuron	2,301	metolachlor	6,431	other	46
pendimethalin	108,923	other	63	total	19,294
rimsulfuron	5,048	total	18,903	barley	
trimethylsulfonium salt of glyphosate	1,875	canola		2,4-D amines	10,851
other	437	2,4-D amines	264	2,4-DB (butyl ester)	14,410
total	1,982,949	ethalfluralin	1,659	atrazine	3,437
soybeans		fluazifop-p-butyl	204	bentazon	3,437
acifluofen	5,198	glyphosate	7,665	bromoxynil	4,621
amitrole	1,443	quizalofop-ethyl	633	dicamba	932
ammonium sulfamate	4,187	trifluralin	1,677	diclofop-methyl	876
bentazon	122,595	other	166	glyphosate	16,148
bromoxynil	6,354	total	12,269	MCPA	11,432
dimethenamid	16,683	hay		MCPA/MCPB	18,217
diquat	992	2,4-D amines	6,028	mecoprop salts,acids	391
ethalfluralin	5,643	2,4-DB (butyl ester)	3,034	tralkoxydim	415
fenoxaprop-ethyl	715	difenzoquat	597	other	19
fluazifop-p-butyl	907	glyphosate	36,040	total	85,186
flumetsulam	10,018	MCPA	331	mixed grain	
fomesafen	5,164	other	12	2,4-D amines	11,369
glyphosate	375,109	total	46,041	2,4-DB (butyl ester)	15,309
imazethapyr	47,251	pasture		bromoxynil	2,246
linuron	24,582	2,4-D amines	9,364	dicamba	508
metobromuron	362	2,4-DB (butyl ester)	1,803	glyphosate	8,060
metolachlor	552,963	ammonium sulfamate	750	MCPA	13,231
metribuzin	65,224	glyphosate	34,492	MCPA/MCPB	12,856
pendimethalin	5,529	MCPA/MCPB	294	mecoprop salts,acids	437
quizalofop-ethyl	2,443	mecoprop salts,acids	253	trimethylsulfonium salt of glyphosate	676
sethoxydim	1,071	other	160	other	123
thifensulfuron-methyl	258	total	47,116	total	64,814
trifluralin	13,039	spring wheat		tobacco	
trimethylsulfonium salt of glyphosate	6,614	2,4-D amines	776	glyphosate	420
other	279	2,4-DB (butyl ester)	1,271	imazethapyr	1,990
total	1,274,624	bromoxynil	2,165	metsulfuron-methyl	505
rye		diclofop-methyl	486	napropamide	4,606
2,4-D amines	4,438	glyphosate	5,303	other	207
glyphosate	5,737	MCPA	5,419	total	7,728
MCPA/MCPB	285	MCPA/MCPB	5,328	Total Herbicides	3,763,481
other	77	other	98		
total	10,538	total	20,847		

Appendix II - Quantities of Specific Pesticide Active Ingredients Used on Field Crops in Ontario, 1998 (continued)

Pesticide by Crop	Quantity	Pesticide by Crop	Quantity	Pesticide by Crop	Quantity
Insecticides	kg	Fungicides	kg	Growth Regulators	kg
field corn		soybeans		tobacco	
dimethoate	2,913	other	223	ethephon	415
propoxur	3,590	total	223	fatty alcohol - N-decanol	200,708
tefluthrin	1,487	all wheat		total	201,122
other	72	propiconazole	1,955	other field crops	152
total	8,062	total	1,955	Total Growth Regulators	201,275
soybeans		tobacco			
cypermethrin	4,647	benomyl	580		
other	312	copper sulfate	1,213		
total	4,960	fosetyl-al	7,126	Total All Pesticides	4,293,051
white beans		other	21		
dimethoate	1,140	total	8,941		
total	1,140	other field crops	99		
pasture		Total Fungicides	11,218		
dimethoate	253	Nematocides			
total	253	soybeans			
tobacco		dazomet	8,129		
acephate	18,382	other	31		
carbaryl	2,355	total	8,161		
chlorpyrifos	1,260	tobacco			
deltamethrin	8,945	1,3 dichloropropene	170,923		
diazinon	293	chloropicrin	46,022		
permethrin	455	dichloropropene	1,425		
other	244	methyl isothiocyanate	44,060		
total	31,934	total	262,429		
other field crops	138	Total Nematocides	270,590		
Total Insecticides	46,488				

**Appendix III - Quantities of Specific Pesticide Active Ingredients Used on All Fruit
in Ontario, 1998**

Pesticide Used	Quantity	Pesticide Used	Quantity
	kilograms		kilograms
HERBICIDES		INSECTICIDES	
2,4-D amines (p)	1,726	azinphos-methyl	13,288
bromoxynil (o)	205	<u>Bacillus thuringiensis</u>	866
diuron (o)	917	carbaryl	6,102
glyphosate (o)	3,283	chlorpyrifos	2,152
napropamide (o)	1,164	cypermethrin	310
paraquat (o)	1,411	diazinon	3,396
simazine (t)	2,651	dicofol	736
terbacil (o)	974	dinocap	1,576
other	1,346	endosulfan	3,385
Total	13,678	imidacloprid	287
FUNGICIDES		phosalone	5,068
benomyl	419	phosmet	30,859
captan	101,169	pirimicarb	317
chlorothalonil	8,636	pyridaben	506
copper oxychloride	2,706	tebufenozide	237
copper sulfate	1,622	other	1,038
dodine	1,452	Total	70,121
ferbam	5,756	NEMATOCIDES	
folpet	6,373	Total	5
fosetyl-al	245	GROWTH REGULATORS	
iprodione	4,505	Total	60
lime sulphur	1,563	GRAND TOTAL	
mancozeb	136,289		543,061
maneb	1,744	(t) triazine herbicide	
metalaxyl	214	(p) phenoxy herbicide	
metiram	125,890	(o) other herbicide	
myclo-butinal	3,454	Note: Totals may not add due to rounding.	
streptomycin	239		
sulphur	55,670		
triforine	611		
zineb	468		
other	174		
Total	459,197		

**Appendix IV - Quantities of Specific Pesticide Active Ingredients Used on All Vegetables
in Ontario, 1998**

Pesticide Used	Quantity	Pesticide Used	Quantity
	kilograms		kilograms
HERBICIDES		INSECTICIDES	
2,4-D amines (p)	367	acephate	1,214
atrazine (t)	20,659	azinphos-methyl	637
bentazon (o)	4,703	<u>Bacillus thuringiensis</u>	342
bromoxynil (o)	850	carbaryl	6,878
cyanazine (t)	1,578	carbofuran	2,521
cycloate (o)	1,066	chlorpyrifos	3,897
diquat (o)	3,606	cypermethrin	1,281
diuron (o)	841	diazinon	689
EPTC (o)	1,963	dimethoate	1,656
EPTC/R25788 (o)	3,109	endosulfan	3,521
ethalfluralin (o)	1,166	imidaclorpid	2,678
fenoxaprop-p-ethyl (o)	620	malathion	312
fomesafen (o)	440	methamidophos	651
glyphosate (o)	13,538	naled	786
imazethapyr (o)	398	oxydemeton-methyl	403
linuron (o)	11,851	parathion	453
MCPA (p)	955	permethrin	982
metobromuron (o)	378	phosmet	455
metolachlor (o)	40,000	terbufos	1,297
metribuzin (t)	5,775	trichlorfon	2,013
napropamide (o)	852	other	652
paraquat (o)	581	Total	33,320
pendimethalin (o)	805		
pyrazon (o)	600		
simazine (t)	384		
trifluralin (o)	5,994	NEMATOCIDES	
other	916	1,3 dichloropropene	6,074
Total	123,994	metam-sodium	11,292
		methyl isothiocyanate	3,037
FUNGICIDES		Total	20,403
chlorothalonil	103,889		
copper sulfate	14,608		
cupric hydroxide	11,356		
fosetyl-al	285	GRAND TOTAL	331,363
iprodione	324		
mancozeb	14,457		
metiram	5,223		
vinclozolin	324	(t) triazine herbicide	
zineb	3,024	(p) phenoxy herbicide	
other	158	(o) other herbicide	
Total	153,647	Note: Totals may not add due to rounding.	

**Appendix V - Quantities of Specific Pesticide Active Ingredients Used on Other
Agricultural Crops* in Ontario, 1998**

Pesticide Used	Quantity	Pesticide Used	Quantity
	kilograms		kilograms
HERBICIDES		FUNGICIDES	
2,4-D amines (p)	2,528	chlorothalonil	8,227
2,4-DB (butyl ester) (p)	996	fosetyl-al	9,797
glyphosate (o)	10,681	iprodione	296
mecoprop salts, acids (p)	1,237	mancozeb	5,523
MCPA (p)	234	metalaxyl	1,047
MCPA/MCPB (p)	217	quintozene	822
simazine (t)	1,865	other	31
other	304	Total	25,743
Total	18,062		
INSECTICIDES		GRAND TOTAL	
			46,926
dimethoate	2,750		
malathion	227		
other	144		
Total	3,121		

(t) triazine herbicide

(p) phenoxy herbicide

(o) other herbicide

Note: Totals may not add due to rounding.

* 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 Fruit Crops in 1998,
by Crop, Ontario**

Crop	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
- kilograms -								
Apples	417	1,909	1,966	308,195	49,971	-	60	362,517
Blueberries	49	-	98	526	127	-	-	800
Cherries	23	-	188	7,591	4,420	-	-	12,222
Grapes	1,931	16	4,025	93,032	6,449	-	-	105,454
Peaches	-	-	169	28,811	4,629	-	-	33,610
Pears	-	-	5	9,969	2,353	-	-	12,327
Plums/Prunes	-	-	32	3,420	615	-	-	4,068
Raspberries	231	4	100	1,897	315	-	-	2,546
Strawberries	-	256	2,253	5,254	1,046	5	-	8,814
Other Fruit	-	-	7	501	195	-	-	702
Total	2,651	2,185	8,842	459,197	70,121	5	60	543,061

Note: Totals may not add due to rounding.

**Appendix VII - Quantities of Active Ingredients of Each Type of Pesticide Used on Vegetable Crops in 1998,
by Crop, Ontario**

Crop	Herbicides			Fungicides	Insecticides	Nematocides	Growth Regulators	Total
	Triazine	Phenoxy	Other					
- kilograms -								
Asparagus	608	86	1,202	200	490	-	-	2,586
Beans, green & wax	13	-	10,994	324	207	-	-	11,538
Beets	-	-	1,667	-	0	-	-	1,667
Broccoli	-	-	320	1,758	1,159	-	-	3,237
Cabbage, chinese	-	-	-	962	575	-	-	1,538
Cabbage, other	-	-	159	1,680	1,220	-	-	3,059
Carrots	100	-	1,543	6,690	1,190	-	-	9,523
Cauliflower	-	-	3	-	1,044	-	-	1,047
Corn, sweet	11,618	362	33,910	42	11,292	-	-	57,225
Cucumbers, field	-	38	506	2,112	2,087	-	-	4,743
Lettuce	-	-	22	949	1,665	-	-	2,636
Onions	11,000	-	672	5,232	711	-	-	17,615
Peas	-	1,089	4,006	-	143	-	-	5,238
Peppers	-	2	228	2,897	1,838	2,872	-	7,838
Potatoes	2,801	-	23,383	60,381	4,985	-	-	91,551
Pumpkin/Squash	-	-	852	45	192	-	-	1,089
Rutabagas	-	-	155	-	3,342	-	-	3,497
Spinach	-	-	947	-	38	-	-	986
Tomatoes, field	2,356	-	12,274	70,374	823	17,531	-	103,359
Other Vegetables	-	-	1,075	-	317	-	-	1,392
Total	28,497	1,578	93,919	153,647	33,320	20,403	0	331,363

Note: Totals may not add due to rounding.

Appendix VIII - Quantities of Active Ingredients of Each Type of Pesticide Used on All Surveyed Crops in Ontario, 1998

Crop	Herbicides				Total nsecticides	Fungicides	Nematocides	Growth Regulators	Total Pesticides	Percentage of Usage by Crop %
	Triazine	Phenoxy	Other	Total						
	- tonnes -									
Field Corn	621.6	224.6	1,136.7	1,982.9	8.1	-	-	0.2	1,991.2	38.2
Soybeans	65.2	-	1,209.4	1,274.6	5.0	0.2	8.2	-	1,288.0	24.7
Dry Beans	-	0.3	35.9	36.1	1.1	-	-	-	37.3	0.7
Tobacco	-	0.0	7.7	7.7	31.9	8.9	262.4	201.1	512.2	9.8
Grains ^a	4.2	218.3	134.2	356.6	0.0	2.1	-	-	358.7	6.9
Canola	-	0.3	12.0	12.3	0.1	-	-	-	12.4	0.2
Hay and Pasture	-	21.3	71.9	93.2	0.3	-	-	-	93.4	1.8
Field Crops	691.0	464.7	2,607.8	3,763.5	46.5	11.2	270.6	201.3	4,293.0	82.3
Fruit	2.7	2.2	8.8	13.7	70.1	459.2	-	0.1	543.1	10.4
Vegetables	28.5	1.6	93.9	124.0	33.3	153.6	20.4	-	331.4	6.4
Other Crops	1.9	5.4	10.8	18.1	3.1	25.7	-	-	46.9	0.9
All Surveyed Crops	724.0	473.8	2,721.4	3,919.2	153.0	649.8	291.0	201.3	5,214.4	100.0
% of Usage by Pesticide Grouping	13.9	9.1	52.2	75.2	2.9	12.5	5.6	3.9	100.0	

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

Note: Totals may not add due to rounding.

Appendix IX - Quantities of Specific Pesticide Active Ingredients Used on All Surveyed Crops in Ontario, 1998

Pesticide Used	Quantity	Pesticide Used	Quantity	Pesticide Used	Quantity
Herbicides	kg	Insecticides	kg	Fungicides	kg
2,4-D amines (p)	96,384	acephate	19,596	benomyl	999
2,4-DB (butyl ester) (p)	49,259	azinphos-methyl	14,120	captan	101,276
acifluorfen (o)	5,218	<u>Bacillus thuringiensis</u>	1,207	chlorothalonil	120,751
amitrole (o)	1,849	carbaryl	15,334	copper oxychloride	2,706
ammonium sulfamate (o)	4,937	carbofuran	2,652	copper sulfate	17,442
atrazine (t)	598,206	chlorpyrifos	7,311	cupric hydroxide	11,410
bentazon (o)	152,880	cypermethrin	6,310	dodine	1,452
bromoxynil (o)	58,854	deltamethrin	9,104	ferbam	5,756
butylate (o)	7,508	diazinon	4,531	folpet	6,373
clopyralid (o)	2,335	dicofol	736	fosetyl-al	17,453
cyanazine (t)	49,038	dimethoate	8,829	iprodione	5,204
cycloate (o)	1,066	dinocap	1,576	lime sulphur	1,563
dicamba (p)	205,522	endosulfan	6,909	mancozeb	156,269
dichlorprop (o)	1,692	imidaclorpid	2,965	maneb	1,873
diclofop-methyl (o)	1,474	malathion	692	metalaxyl	1,354
difenzoquat (o)	597	methamidophos	651	metiram	131,113
dimethenamid (o)	102,828	methidathion	238	myclo-butinal	3,462
diquat (o)	4,794	naled	786	propiconazole	2,051
diuron (o)	1,758	oxydemeton-methyl	450	quintozene	822
EPTC (o)	12,651	parathion	539	streptomycin	239
EPTC/R25788 (o)	33,687	permethrin	1,444	sulphur	55,670
ethalfluralin (o)	9,500	phosalone	5,073	triforine	611
fenoxaprop-ethyl (o)	715	phosmet	31,344	vinclozolin	324
fenoxypop-p-ethyl (o)	620	pirimicarb	459	zineb	3,492
fluazifop-p-butyl (o)	1,174	propoxur	3,590	other	139
flumetsulam (o)	10,974	pyridaben	506	total	649,805
fomesafen (o)	6,786	tebufenozide	237		
glufosinate ammonium (o)	1,644	tefluthrin	1,487		
glyphosate (o)	647,494	terbufos	1,297	Nematocides	
imazethapyr (o)	52,028	trichlorfon	2,013	1,3 dichloropropene	177,001
linuron (o)	38,637	other	1,061	chloropicrin	46,022
MCPA (p)	52,730	total	153,049	dazomet	8,129
MCPA/MCPB (p)	66,997			dichloropropene	1,425
mecoprop salts,acids (p)	2,899			metam-sodium	11,292
metobromuron (o)	8,200			methyl isothiocyanate	47,097
metolachlor (o)	1,376,570			other	31
metribuzin (t)	71,761			total	290,998
metsulfuron-methyl (o)	505				
N-alkyl dimethyl benzyl ammonium chloride (o)	235			Growth Regulators	
napropamide (o)	6,622			ethephon	415
nicosulfuron (o)	2,301			fatty alcohol - N-decanol	200,708
paraquat (o)	2,031			other	213
pendimethalin (o)	115,687			total	201,335
pyrazon (o)	600				
quizalofop-ethyl (o)	3,076			All Pesticides	
rimsulfuron (o)	5,091			total	5,214,402
sethoxydim (o)	1,366				
simazine (t)	4,901				
terbacil (o)	974				
thifensulfuron-methyl (o)	343				
tralkoxydim (o)	518				
trifluralin (o)	23,250				
trimethylsulfonium salt of glyphosate (o)	9,306				
other	1,140				
total	3,919,215				

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

Note: Totals may not add due to rounding.

**Appendix X - Quantities of Active Ingredients of Each Type of Pesticide Used on All Surveyed Crops in 1998,
by Region and County, Ontario**

	Herbicides				Fungicides	Insecticides	Nematocides	Growth Regulators	Total Pesticides
	Triazine	Phenoxy	Other	Total					
	- kilograms -								
Brant	14,298	7,767	50,604	72,669	11,871	5,531	28,456	21,477	140,003
Elgin	36,633	16,332	143,067	196,032	20,138	9,394	40,453	30,279	296,296
Essex	27,599	13,050	162,057	202,706	57,805	7,778	6,344	299	274,932
Haldimand-Norfolk	26,766	16,300	122,357	165,422	75,519	31,224	148,884	112,422	533,470
Hamilton-Wentworth	9,254	5,838	33,986	49,077	23,838	4,543	298	4	77,761
Kent	63,759	27,143	267,080	357,982	47,173	4,946	17,838	5,116	433,056
Lambton	38,451	20,118	234,922	293,491	16,078	3,729	2,361	760	316,421
Middlesex	59,157	28,695	229,027	316,879	15,247	8,187	12,623	9,078	362,014
Niagara	11,946	6,071	43,142	61,159	138,741	17,870	400	6	218,176
Oxford	50,076	23,907	144,190	218,173	16,841	7,476	26,765	20,240	289,495
Southern Ontario	337,937	165,221	1,430,431	1,933,590	423,252	100,680	284,424	199,681	2,941,625
Bruce	22,629	21,832	86,664	131,125	2,717	1,063	272	5	135,182
Dufferin	3,647	7,863	20,172	31,682	8,645	1,004	36	1	41,368
Grey	8,101	18,337	30,430	56,867	69,239	11,492	35	15	137,648
Halton	5,619	3,922	24,652	34,193	6,326	1,454	214	2	42,189
Huron	61,892	36,251	227,812	325,955	6,293	4,853	732	14	337,846
Peel	6,052	4,968	21,571	32,591	6,211	1,215	114	2	40,133
Perth	43,774	28,241	150,198	222,213	1,262	2,302	388	10	226,175
Simcoe	24,568	19,801	85,834	130,204	33,978	5,563	900	475	171,119
Waterloo	20,451	14,080	55,442	89,974	4,602	1,340	136	5	96,057
Wellington	25,786	25,047	92,181	143,014	3,737	1,541	288	6	148,586
Western Ontario	222,520	180,342	794,956	1,197,818	143,008	31,827	3,114	537	1,376,304
Durham	18,519	12,684	57,984	89,186	17,435	3,798	710	352	111,481
Hastings	6,228	5,847	17,038	29,112	1,987	722	54	2	31,876
Northumberland	12,754	9,057	42,263	64,074	22,026	4,832	956	611	92,498
Peterborough	5,027	5,276	15,765	26,068	953	345	43	1	27,410
Prince Edward	5,850	4,122	20,386	30,358	6,214	2,042	98	2	38,714
Victoria	8,259	7,650	29,399	45,307	1,627	448	251	123	47,756
York	14,597	7,592	43,422	65,611	12,069	2,825	574	3	81,082
Other	97	726	1,404	2,227	499	132	8	0	2,866
Central Ontario	71,329	52,953	227,660	351,942	62,810	15,142	2,695	1,094	433,683
Frontenac	2,062	2,360	6,046	10,468	450	154	10	1	11,082
Lanark	3,311	3,253	10,084	16,648	944	264	24	1	17,882
Leeds and Grenville	8,776	6,065	22,711	37,553	2,777	656	46	3	41,035
Lennox and Addington	3,784	3,648	11,951	19,383	1,536	382	49	1	21,350
Ottawa-Carleton	16,917	10,386	46,935	74,239	3,044	1,023	200	4	78,510
Prescott and Russell	16,636	10,341	46,508	73,485	2,045	617	110	4	76,261
Renfrew	3,317	6,179	11,730	21,225	1,734	338	12	1	23,310
Stormont, Dundas and Glengarry	36,026	18,185	95,804	150,015	3,364	1,257	238	9	154,882
Eastern Ontario	90,828	60,417	251,770	403,015	15,894	4,690	690	23	424,312
Timiskaming	399	6,759	5,428	12,586	253	68	5	0	12,912
Other	997	8,099	11,167	20,264	4,588	644	71	0	25,567
Northern Ontario	1,396	14,858	16,595	32,850	4,841	712	76	0	38,478
Ontario	724,011	473,792	2,721,413	3,919,215	649,805	153,050	290,998	201,335	5,214,402

Note: Totals may not add due to rounding.

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

Crop	Pesticide or Group	Active Ingredient Used			
		1983	1988	1993	1998
		- kilograms -			
field corn	alachlor	614,680	940	-	-
	atrazine	1,719,840	999,410	585,208	573,721
	metolachlor	491,020	712,170	897,870	773,833
	all herbicides	3,653,310	2,491,370	2,351,146	1,982,949
soybeans	alachlor	436,800	1,190	-	-
	metolachlor	325,450	915,170	391,152	552,963
	all herbicides	1,281,880	1,694,770	1,133,103	1,274,624
grains	all herbicides	376,140	491,320	443,620	356,641
tobacco	all nematocides	1,610,610	766,810	537,118	262,429
total field crops	all herbicides	5,411,260	4,984,560	4,143,523	3,763,481
	all pesticides	7,800,480	6,206,580	5,211,758	4,293,051
total fruit	all fungicides	410,990	429,610	457,509	459,197
	all pesticides	562,640	598,560	628,111	543,061
total vegetables	all pesticides	356,120	396,330	406,573	331,363
total field crops, fruit & vegetables	all pesticides	8,719,240	7,201,470	6,246,442	5,167,475

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

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

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