

PESTICIDE USAGE IN NORTHERN IRELAND
SURVEY REPORT 231

NORTHERN IRELAND TOP FRUIT CROPS 2008



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PESTICIDE USAGE SURVEY REPORT 231

Northern Ireland Top Fruit Crops

2008

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The County Regions of Northern Ireland

SUMMARY

This report presents information from a survey of the pesticide usage practices of top fruit growers in Northern Ireland in 2008. It is the fifth pesticide survey to be conducted on top fruit crops in the region since 1992.

An estimated 250 top fruit orchards were surveyed in Northern Ireland in 2008 with information on crop applications, storage treatments and orchard floor treatments being recorded. The total area of top fruit crops grown in 2008 increased by 2% to 1,482 hectares when compared with the previous survey in 2006. Approximately 95% of all top fruit crops were grown in County Armagh, with Bramley apple orchards accounting for 99% of the total top fruit grown in Northern Ireland.

Overall, an estimated 26 tonnes of pesticide active ingredients were applied to 32,831 spray hectares. The pesticide-treated area increased by 14% compared with 2006, and the weight of active ingredients applied increased by 19%.

In common with previous years, fungicides were the most frequently applied pesticide. When compared to 2006, fungicide application in area treated and weight applied increased by 10% and 17%, respectively. During 2008, fungicides were applied to 83% of the pesticide-treated area and accounted for 90% of the weight of pesticides used. The fungicides dithianon and mancozeb were the active ingredients most commonly used on top fruit crops. An estimated 73% of all fungicide applications were applied to control apple scab (*Venturia inaequalis*).

The area treated with insecticides and acaricides increased by 19% when compared with 2006. Insecticides and acaricides were applied to 8% of the entire pesticide-treated area, accounting for 4% of the total weight of pesticides used. The organophosphate insecticide chlorpyrifos was the most frequently applied insecticide/acaricide. An estimated 21% of insecticide/acaricide applications were to control aphids.

Overall, the area treated and weight of herbicides applied increased by 7% and 38%, respectively, when compared with 2006. Glyphosate was the herbicide active ingredient most frequently used with 'general weed control' under the tree canopy the reason for use.

Growth regulators accounted for 6% of the pesticide-treated area but less than 1% of the total weight of pesticide applied. Prohexadione-calcium was the growth regulator active ingredient most frequently used with applications increasing four fold.

An estimated 24 tonnes of 'other products', including foliar feeds, trace elements and calcium-based products, were also applied to the crops during this survey period. This represented a 63% increase when compared to 2006. This large increase was due to the method reported in this survey. The majority of applications were to treat potential nutritional disorders.

Herbicides applied in ‘strips’ under the tree canopy with inter-row grass being mowed was, as in previous years, the most common weed management practice (used in 68% of orchards). The inter-row areas of all orchards surveyed were mown for grass and weed control. An estimated 31% of orchards did not apply herbicides for grass and weed control.

Data was also collected on post-harvest storage treatments applied to top fruit crops. An estimated 17,318 tonnes of top fruit crops were stored, 16,330 tonnes of which were treated. The antioxidant fungicide diphenylamine was the most commonly used pesticide active ingredient applied to stored fruit. A total of three products (three pesticide active ingredients and one trace element) were recorded in use on stored top fruit crops.

In contrast with previous reports, new orchard plantations (“non-fruiting”) were not included in this report.

DEFINITIONS AND NOTES

- ‘Basic area’ refers to the actual planted area of crop, which was treated with a given pesticide.
- ‘Treated area’ refers to the total area treated with a pesticide, which includes all repeated applications to the basic area.
- ‘Reasons for use’; the reasons reported for the use of pesticides are the growers stated reason for use and may sometimes be inappropriate.
- ‘Rounding’, due to rounding of figures, there may be slight differences in totals both within and between tables.
- Generally, orchards recorded in this survey are laid out with trees planted in rows and the area between rows, referred to in the report as the ‘inter-row’ area, is sown with grass. ‘Herbicide strips’, refers therefore to the area between the trees as opposed to the ‘inter-row’ area.
- Non-fruiting and fruiting crops were combined and recorded only as “Bramley” and “dessert and plums” in this years survey which covered all ages of top fruit crops.
- Dessert apples and plum crops were combined in this survey due to the small number of these orchard types recorded.
- ‘Spray applications’ refers to the number of treatments by any pesticide type to the treated areas.
- ‘Spray round’ refers to the number of times the crop was sprayed accounting for tank mixes.

INTRODUCTION

As a participant in the UK Working Party on Pesticide Usage Surveys, the Agri-Food and Biosciences Institute (AFBI) on behalf of the Department of Agriculture and Rural Development for Northern Ireland (DARDNI), conducts a programme of surveys to examine pesticide usage in all sectors of the agricultural and horticultural industries. Principally, the data collected provides information for consideration by the Advisory Committee on Pesticides. In addition, the information may also be used by those involved in residue testing, for public information and to evaluate the impact of policy and trends in pesticide usage.

This is the fifth survey of pesticide usage on top fruit crops in Northern Ireland. Results from the previous surveys reported on pesticide usage practices on top fruit crops in 1992 (Kidd *et al.*, 1994), 1997 (Kidd *et al.*, 2001), 2002 (Kearns *et al.*, 2004) and 2006 (Kearns *et al.*, 2007) are included in the report for comparative purposes.

A list of published Northern Ireland Pesticide Usage Survey reports is shown in Appendix 1.

METHODS

Using the Northern Ireland Agricultural Census, June 2007 (Anon., 2008), a sample of holdings to be surveyed was selected. The sample was stratified into four county regions of Northern Ireland, (there is limited top fruit production in counties Londonderry and Fermanagh which were omitted from this survey) and into five size groups based on the total area of top fruit crops grown in each county. The total number of holdings in each county, together with the numbers surveyed are shown in Table 1.

This survey includes the period from the end of the 2007 harvest to the end of the 2008 harvest.

The purpose of the survey was explained to selected growers in preliminary correspondence. A total of 91 holdings (representing 36% of growers) were visited and data collected by personal interview. The growers' perceived reasons for pesticide use were also included, but may not always seem appropriate. Holdings selected in the original sample which were unable to provide data, were replaced with those from the same county and size group held on a reserve list.

The collected data were analysed using SPSS software.

RESULTS AND DISCUSSION

Crops

The number and area of crops sampled, together with the proportion of the crop area surveyed, are shown in Table 2. The data collected provided information on 101 examples of two crop types.

An estimated 95% of the total area of top fruit crops was grown in County Armagh, with Bramley apples accounting for 99% of the total area of top fruit crops grown. Dessert apples and plums collectively accounted for the remaining 1% of the area grown. (Table 3, Figure 1).

Regional Pesticide Usage (Tables 4 & 5, Figure 4 & 5)

Regionally, County Armagh accounted for 94% of the total pesticide-treated area and 95% of the weight of pesticides applied. 4% of the area grown and 5% of the pesticide-treated area were in County Tyrone.

Pesticide Usage on Crops (Tables 6 & 7)

The estimated weights of pesticide active ingredients applied and the area of crop types treated with pesticides are shown in Tables 6 & 7. Bramley apples represented 99% of both the pesticide-treated area and the weight of active ingredients applied. Collectively, dessert apples and plums accounted for less than 1% of the top fruit crops grown, the weight of pesticides applied and the pesticide-treated area.

Number of Spray Applications (Table 8)

The mean number of spray applications of pesticides to top fruit crops is shown in Table 8. All pesticide types were used on all crops and pesticides were applied to 99% of the total area of top fruit crops grown.

All crops treated received fungicides with a mean of 17 fungicide applications and nine spray rounds. Approximately 89% of all crops received insecticide/acaricide applications, with a mean of two spray applications. On average, two applications of growth regulators and 1 application of herbicides were made to top fruit crops.

Total Pesticide Usage (Tables 4 & 5; 9 & 10; 11 & 12, Figures 2 & 3; 4 & 5)

Approximately 26 tonnes of pesticide active ingredients were applied to 32,831 spray hectares of top fruit crops grown in Northern Ireland in 2008 (Tables 4 & 5, Figure 2 & 3). Fungicides were applied to 83% of the pesticide-treated area, representing 90% of the weight of pesticides applied. Herbicides were applied to 3% of the area treated with pesticides, accounting for 5% of the total weight of pesticides used.

Insecticides/acaricides, applied to 8% of the pesticide-treated area, represented 4% of the total weight of pesticide used. Growth regulators represented 6% and less than 1% of the total pesticide-treated area and weight of active ingredients applied, respectively.

The pesticide types and active ingredients applied are shown in Tables 9 and 10. Dithianon, mancozeb and pyrimethanil were the three most frequently used fungicides and accounted for 23%, 20% and 15% of the fungicide treated area respectively and 25%, 42% and 7% of the weight of fungicides used, respectively. Fungicide applications were primarily used to control apple scab (*V. inaequalis*) in orchards.

Glyphosate (63% of herbicide applications) was the most commonly applied herbicide active ingredient accounting for 70% of the weight of herbicide active ingredients applied.

The organophosphorus active ingredient chlorpyrifos accounted for 50% of the insecticide/acaricide-treated area and represented 88% of the weight of pesticides applied. Clofentezine, cypermethrin and tebufenpyrad accounted for 9%, 18% and 15% of the insecticide/acaricide treated area and collectively comprised a further 9% of weight of insecticides/acaricides applied.

Growth regulators were applied to an estimated 2,066 spray hectares of top fruit crops. Paclobutrazol was applied to 25% of the area treated with growth regulators, accounting for 26% of the weight of growth regulators applied. Prohexadione-calcium was applied to 67% of treated area, accounting for 74% of the weight of growth regulators applied. Gibberellins were the only other active ingredient recorded in this group, accounting for less than 1% of weight of growth regulators applied.

The active ingredients recorded, ranked by application area and weight applied, are shown in Tables 11 & 12, respectively.

PESTICIDE USAGE ON INDIVIDUAL CROPS

BRAMLEY APPLE CROPS: (TABLE 13)

Approximately 1,463 hectares of Bramley apple crops were grown in 2008. This represented a 3% increase when compared to 2006. Results from non-fruiting and fruiting orchards were combined and recorded only as “Bramley” in this survey. This comprised all ages of orchards ranging from under 5 years to 35 years and above.

Fungicides

The area of Bramley crops treated with fungicides was similar to that recorded in 2006. An estimated 83% of the area of Bramley apples received fungicide applications and accounted for 90% of the weight of pesticides applied (Table 6 and 7). Approximately 73% of all fungicide applications were to control apple scab (*V. inaequalis*).

Control of canker (*Nectria galligena*) accounted for only 2% of applications to the fungicide-treated area of this crop. This may be due to the limited number of active ingredients recommended for the control of this disease.

Dithianon, applied to 6,304 spray hectares, was the most frequently used fungicide, accounting for 25% of the weight of fungicides applied. Mancozeb, applied to 19% of the fungicide-treated area, accounted for 42% of the weight of fungicides used on Bramley apple crops.

Herbicides

Herbicides applied to inter-row spaces between Bramley apple trees represented 99% of the total herbicide treated area of all fruit crops (Tables 6 & 7) but only 3% of the pesticide-treated area of this crop type. ‘General weed control’, was the principal reason given for usage. In common with 2006, glyphosate was the most frequently applied herbicide, accounting for

63% and 70% of the herbicide-treated area and weight of herbicide active ingredients applied, respectively.

Insecticide/Acaricides

Insecticides and acaricides applied for ‘general insect control’ and to control ‘aphids’, accounted for 53% and 21% of the insecticide/acaricide-treated area, respectively. A further 25% of active ingredients were applied to the treated area to control fruit-tree red spider mite (*Panonychus ulmi*).

Organophosphates accounted for 63% and 87% of the total area treated and weight of insecticide/acaricide active ingredients applied, respectively (Table 17). Pyrethroids were applied to 19% of the insecticide/acaricide-treated area but accounted for only 2% of the weight used. In common with 2006, the organophosphate chlorpyrifos was the principal insecticide/acaricide active ingredient recorded, accounting for 50% of the insecticide/acaricide treated area.

Growth Regulators

Growth regulators were applied to 2,054 spray hectares of Bramley crops accounting for an estimated 99% of the total growth regulator-treated area (Tables 7). Prohexadione-calcium was the active ingredient most frequently used. This represented 67% of the growth regulator treated area and accounted for 74% of the weight applied. Paclobutrazol and gibberellins were applied to 25% and 8% of the area treated with growth regulators, respectively.

Other Products

An estimated 24 tonnes of ‘other products’ were applied to 13,779 spray hectares of Bramley apples (Table 15). ‘Other products’ included foliar feeds, trace elements and calcium-based products of which the majority were used to treat potential nutritional disorders.

Calcium-based products applied as a ‘storage aid’, principally to prevent the nutritional disorder ‘bitter pit’, were applied to 15% of the treated area of ‘other products’ used on Bramley apple orchards. Seaweed extract products were applied to 34% of the area treated with ‘other products’ for this crop.

‘Other products’, used as foliar feeds, accounted for 79% of the treated area of Bramley apple orchards.

DESSERT APPLE AND PLUM CROPS (*Table 14*)

Approximately 19 hectares of dessert apple and plums were grown in 2008. These two crop types have been combined for the purposes of this report. Non-fruiting and fruiting crops were combined and recorded only as “dessert” in this year’s survey which covered all ages in this crop ranging from under 5 years to 35 years and above. For comparison reasons, the overall combined dessert fruiting, non-fruiting and other crops shows a decrease of 53% to 19 hectares between 2006 and 2008.

Fungicides

Of the pesticide applications to dessert apple and plum orchards, fungicides accounted for 93% of the weight of pesticide applied and 81% of the treated area (Tables 6 & 7). An estimated 76% of all fungicide applications were used to control apple scab (*V. inaequalis*) with a further 20% of applications to control powdery mildew (*Podosphaera leucotricha*) and scab. The active ingredients mancozeb (38%) and dithianon (7%) collectively accounted for 45% of the fungicide treated area and 62% of the weight of fungicides applied.

Herbicides

Herbicides accounted for 3% the area treated of this crop and 4% of the weight of pesticide applied (Tables 6 & 7). 'General weed control' was the only reason recorded for herbicide usage on this crop. Glyphosate accounted for approximately 38% of the herbicide-treated area and 56% of the weight of herbicide applied.

Insecticide/Acaricides

Insecticide/acaricides, applied to 27 spray hectares of dessert apple and plum orchards, accounted for 3% of the weight of pesticide applied and 11% of the pesticide-treated area (Table 6 & 7). The active ingredients chlorpyrifos (33%) and cypermethrin (37%) collectively accounted for 70% of the insecticide/acaricide-treated area and 88% of the weight applied. An estimated 21% of all insecticide/acaricide applications were to control 'aphids' and 19% to control 'fruit-tree red spider mite' (*P. ulmi*). The remaining 60% of applications were for 'general insect control'.

Growth Regulators

Only two growth regulators were applied to 13 spray hectares of dessert apples and plum orchards. These were paclobutrazol (15%) and prohexadione-calcium (85%).

COMPARISON WITH PREVIOUS SURVEYS

Comparative information on pesticide usage on top fruit crops grown in Northern Ireland in 1992, 1996, 2002, 2006 and 2008 is included in Tables 16, 17a & b and 17b, Figures 6 - 16.

Area of top fruit crops grown (Table 16)

Overall, the area of top fruit grown in Northern Ireland in 2008 increased marginally (2%) compared with that recorded in 2006. The overall Bramley apple area (combining fruiting and non-fruiting for 2006) increased by 48 hectares (3%). The data indicates a significant decrease in the overall area of dessert apples and plums grown (46%). As in previous surveys the majority of the total top fruit area in Northern Ireland was used for Bramley apple production (99%).

Comparison of pesticide usage (Tables 17a & b, Figures 6 - 13)

There was a 14% increase in the total area of pesticide application to top fruit crops between 2006 and 2008. The weight of pesticides applied in 2008 increased by 19% when compared to 2006 (Figures 6 and 7). Herbicide applications increased by 7% for total area treated and 38% for total weight

of active ingredients applied which can be mainly attributed to the increase in glyphosate usage.

Insecticide/acaricide applications increased by 19% and 33%, in area treated and weight of active ingredients applied, respectively (Figure 10). Applications of carbamate active ingredients have continually increased since 1996; and although the use of organophosphate active ingredients has progressively decreased during the same period to 2006, there was an increase of 25% in the total weight of insecticide/acaricide active ingredients applied between 2006 and 2008.

The quantity of pyrethroids applied in 2008 increased by 28% compared with 2006, but the area treated decreased by 17%.

An estimated 2066 spray hectares were treated with growth regulators in 2008. This was the highest recorded over the five surveys. The weight of growth regulators applied increased by 74% when compared with 2006.

The active ingredients most extensively used for 2008 are shown in Table 17b, which also provides the trend in application from 1992 - 2008.

Storage of Top Fruit Crops (Tables 18 - 21, Figures 14 & 15)

An estimated 17,318 tonnes of Bramley apples were stored from the 2008 harvest, of which 96% received a post-harvest treatment. Approximately 0.5 tonnes of pesticides were applied to 16,630 tonnes of apples all of which were stored in bulk bins in controlled atmosphere stores.

Fungicides, antioxidants and calcium-based products were the only treatments recorded in use.

Fungicide applications accounted for 1% of stored apple crop treatments and 18% of the total weight of active ingredients used. Cyprodinil/fludioxonil was recorded for the first time in 2008 and used to treat storage rots. No other fungicides were recorded in this survey for storage diseases.

The antioxidant diphenylamine, applied solely as a 'storage aid', was the most frequently used active ingredient, accounting for 93% of the treated tonnage and 78% of the weight of all treatments applied.

Calcium based products accounted for 6% of treated tonnage and 4% of the weight of all treatments applied. The perceived reason given for all calcium applications was as a preventative against the nutritional disorder 'bitter pit'.

A total of two active ingredients and one trace element were recorded in use on stored apples. The active ingredients recorded in use during apple storage in 2008 are shown in Table 20.

Comparison with previous surveys of top fruit storage (Table 21, Figure 16)

There was a 12% decrease in the quantity of apples stored in 2008 compared with 2006 and this is also reflected in the quantity of apples treated (Figure 16). The quantity of stored apples treated with antioxidants increased by 25%

in 2008 compared to 2006. Diphenylamine was the only antioxidant used on stored apples.

Overall, fungicide usage decreased by 96% when compared to 2006. The only fungicide active ingredient applied in 2008 was cyprodinil/fludioxinil, which was recorded for the first time on stored apples in Northern Ireland in 2008.

The increase in the use of antioxidants and large decrease in fungicide usage on stored apples may be due to a number of active ingredients which were previously used as storage treatments having approval withdrawn.

ACKNOWLEDGEMENTS

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Kearns, C.A., Jess, S., Matthews, D., McCallion, T. (2004) Top Fruit Crops 2002. *Pesticide Usage Survey Report 147* Belfast: DARDNI

Kearns, C.A., Jess, S., Matthews, D., Kelly, T. (2007) Top Fruit Crops 2006. *Pesticide Usage Survey Report 217* Belfast: AFBI.

Figure 1: The utilisation of top fruit production area in Northern Ireland, 2008.

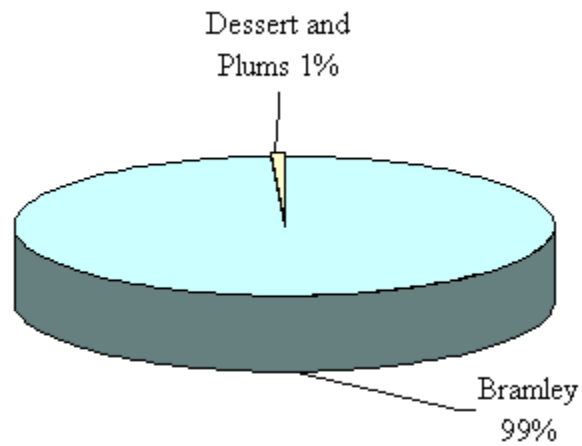


Figure 2: The proportional area (spray hectares) of top fruit crops treated with each pesticide type in Northern Ireland, 2008.

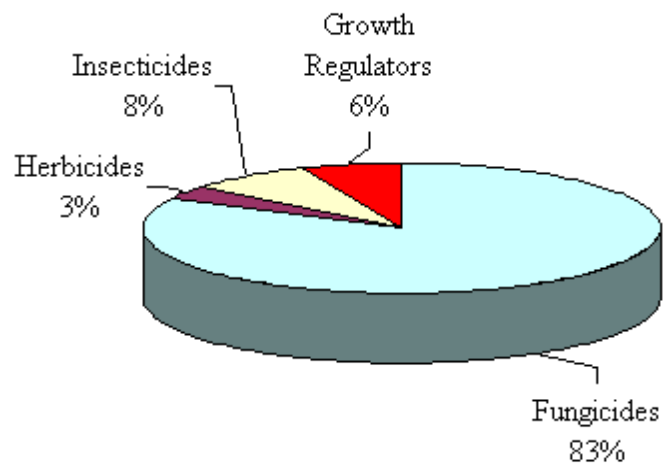


Figure 3: The proportion of top fruit crops treated with each pesticide type by weight (kg).

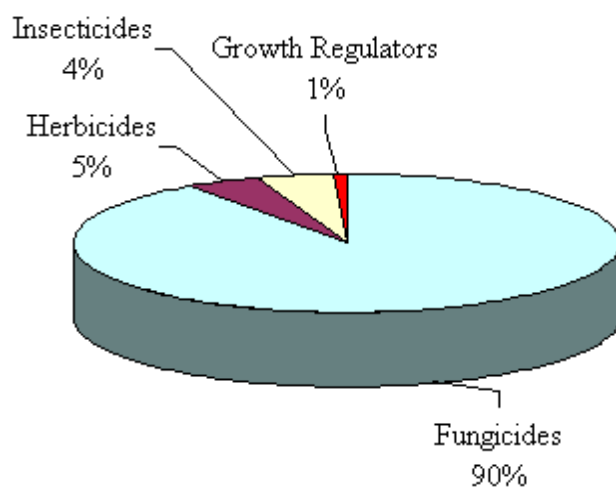


Figure 4: The area of top fruit crops treated (spray hectares) with each pesticide type in the county regions of Northern Ireland, 2008.

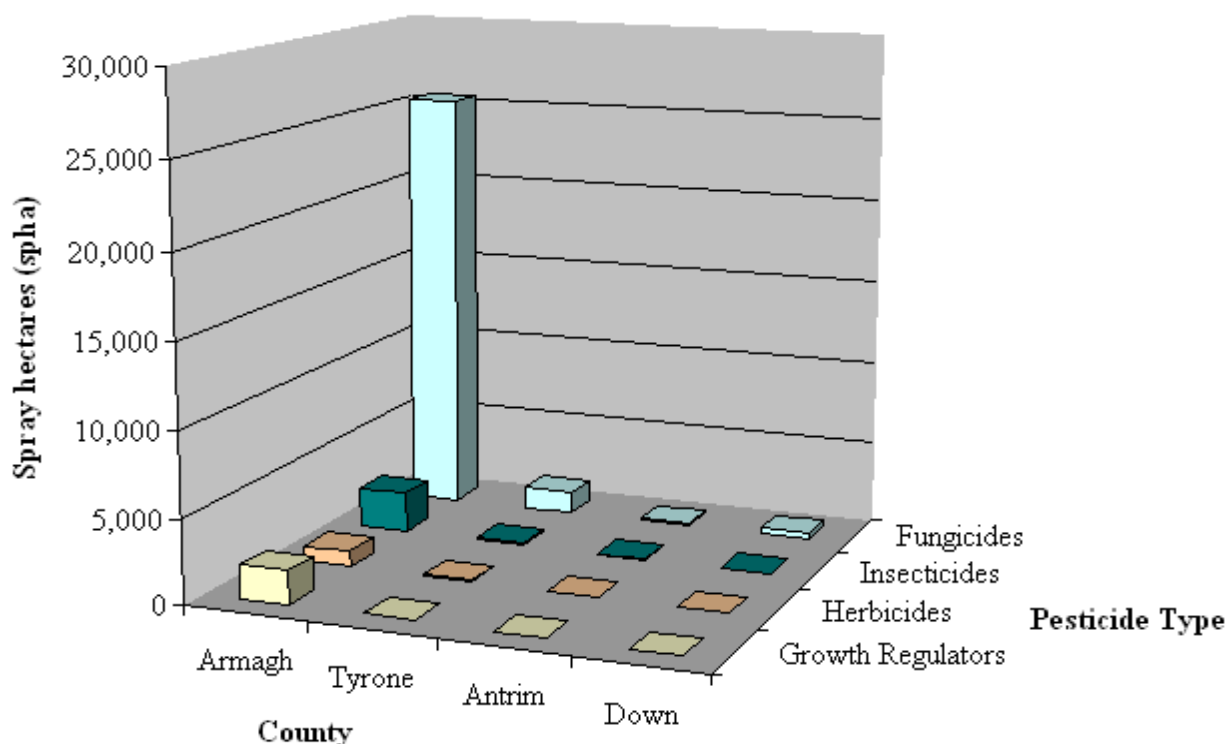


Figure 5: The weight (kg) of each pesticide type applied to top fruit crops in the county regions of Northern Ireland, 2008.

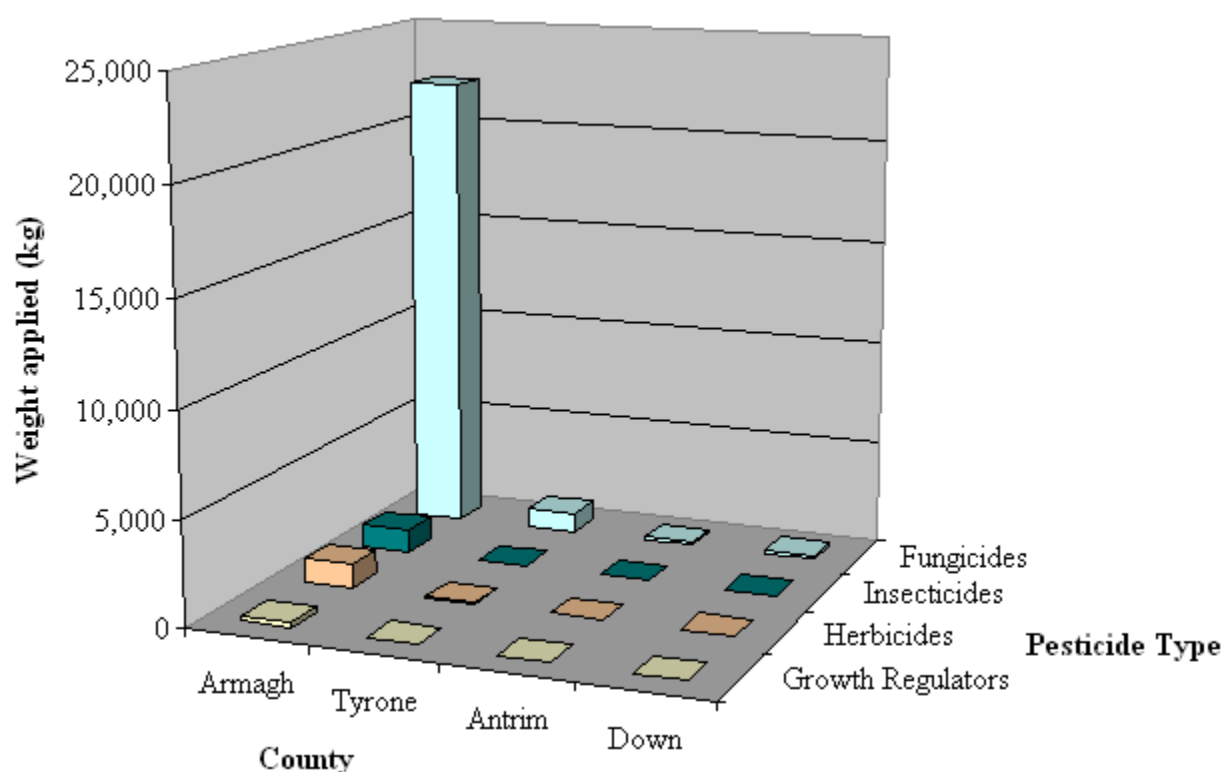


Figure 6: Comparison of pesticide usage on top fruit crops in Northern Ireland 1992-2008, by area treated (spray hectares). Bars show 95% Confidence Interval of estimate.

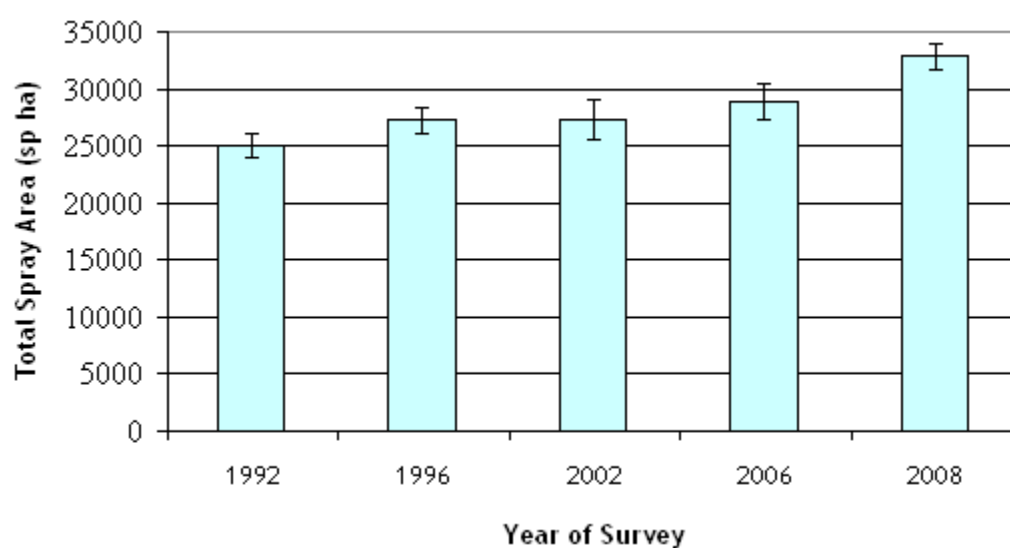


Figure 7: Comparison of pesticide usage on top fruit crops in Northern Ireland 1992-2008, by total weight applied (kg). Bars show 95% Confidence Interval of estimate.

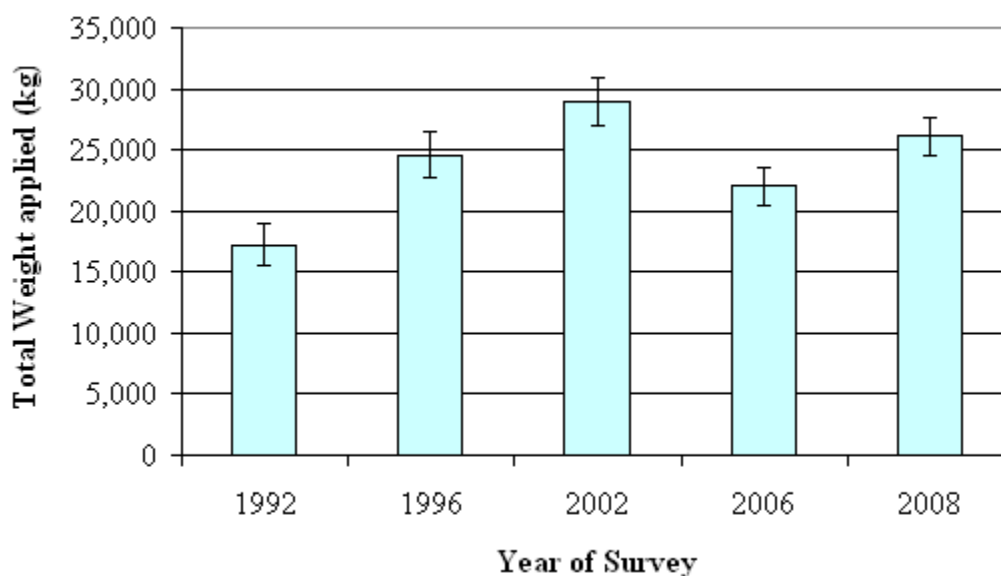


Figure 8: Comparison of pesticide types used on top fruit crops in Northern Ireland 1992-2008 by spray area (spray hectares).

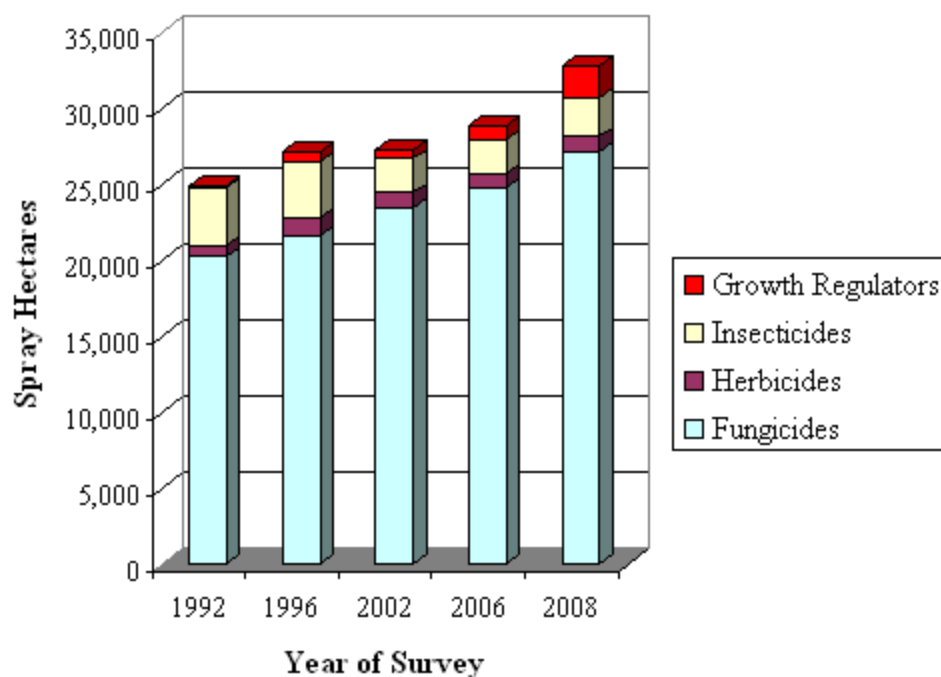


Figure 9: Comparison of pesticide types used on top fruit crops in Northern Ireland 1992-2008 by weight applied (kg).

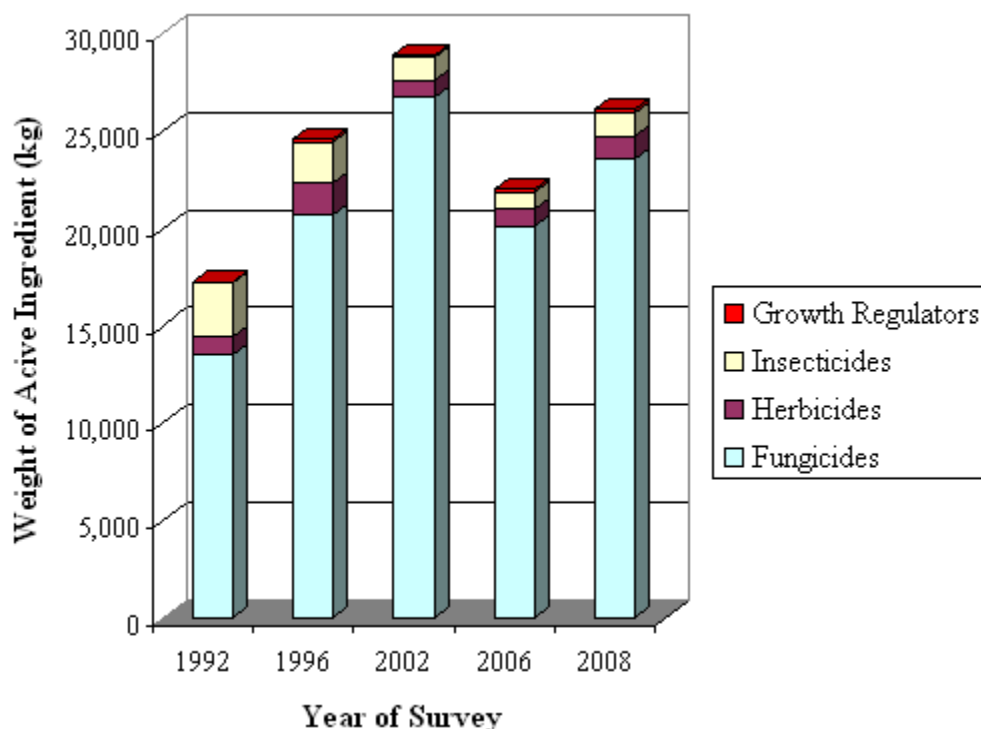


Figure 10: Comparison of insecticide types used on top fruit crops in Northern Ireland 1992-2008, by weight of active ingredients applied (kg).

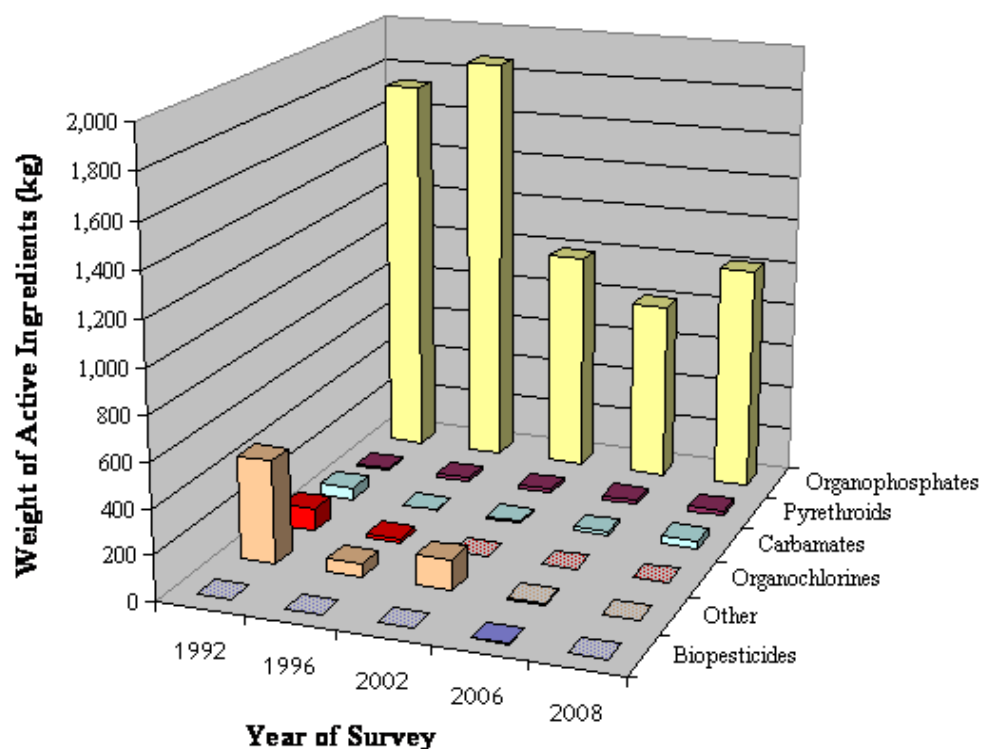


Figure 11: Comparison of application rates for pesticide types used on top fruit crops in Northern Ireland 1992-2008 (kg/spray hectare).

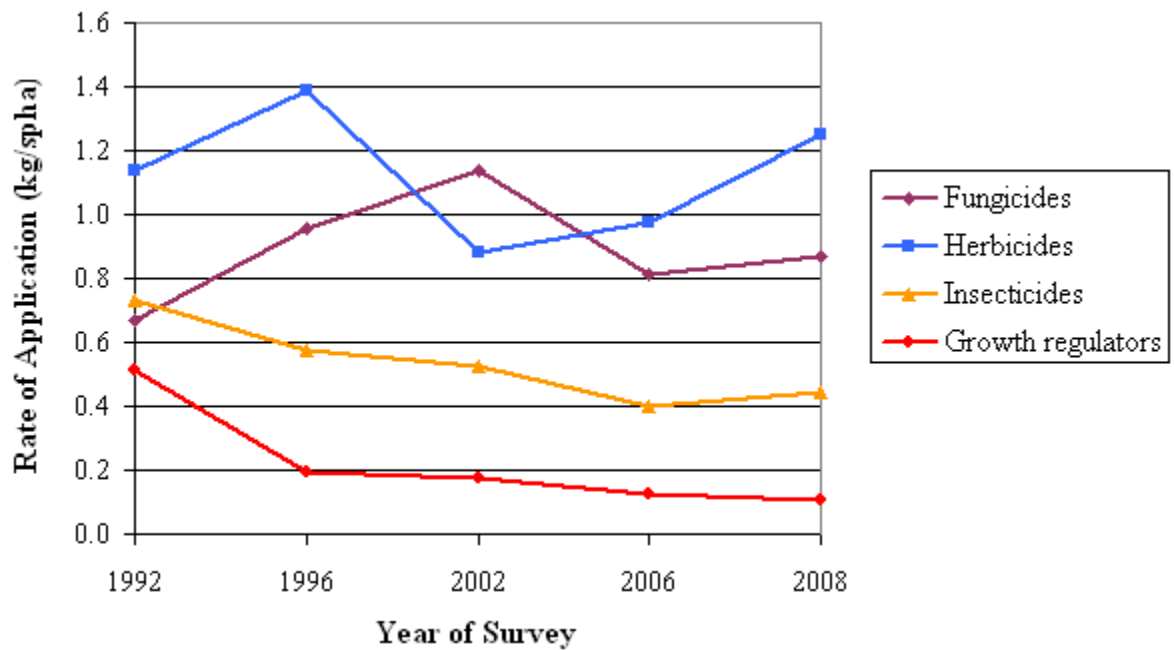


Figure 12: Weight of fungicides applied per hectare of total top fruit crop, Northern Ireland 1992-2008 (kg/ha).

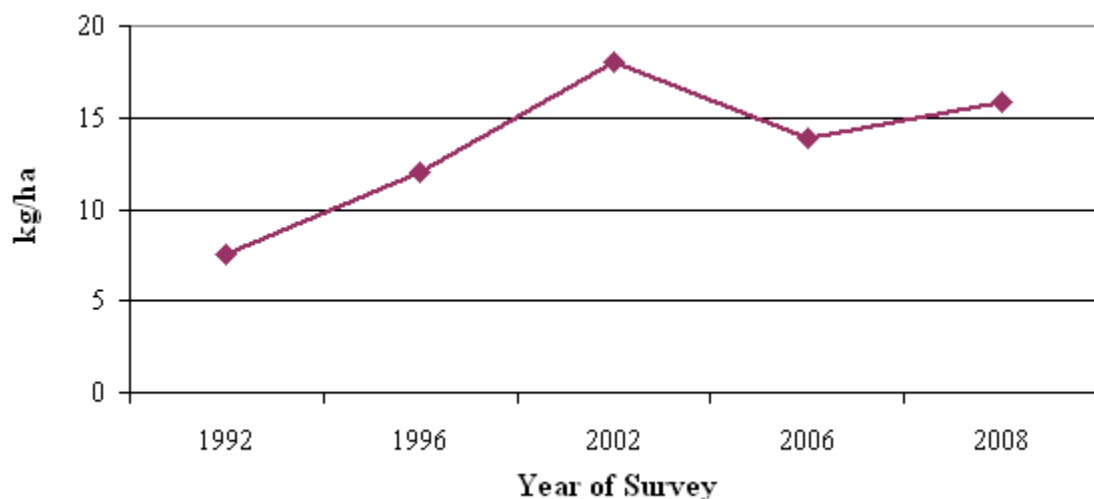


Figure 13: Weight of herbicides, insecticides and growth regulators applied per hectare of total top fruit crop, Northern Ireland 1992-2008 (kg/ha).

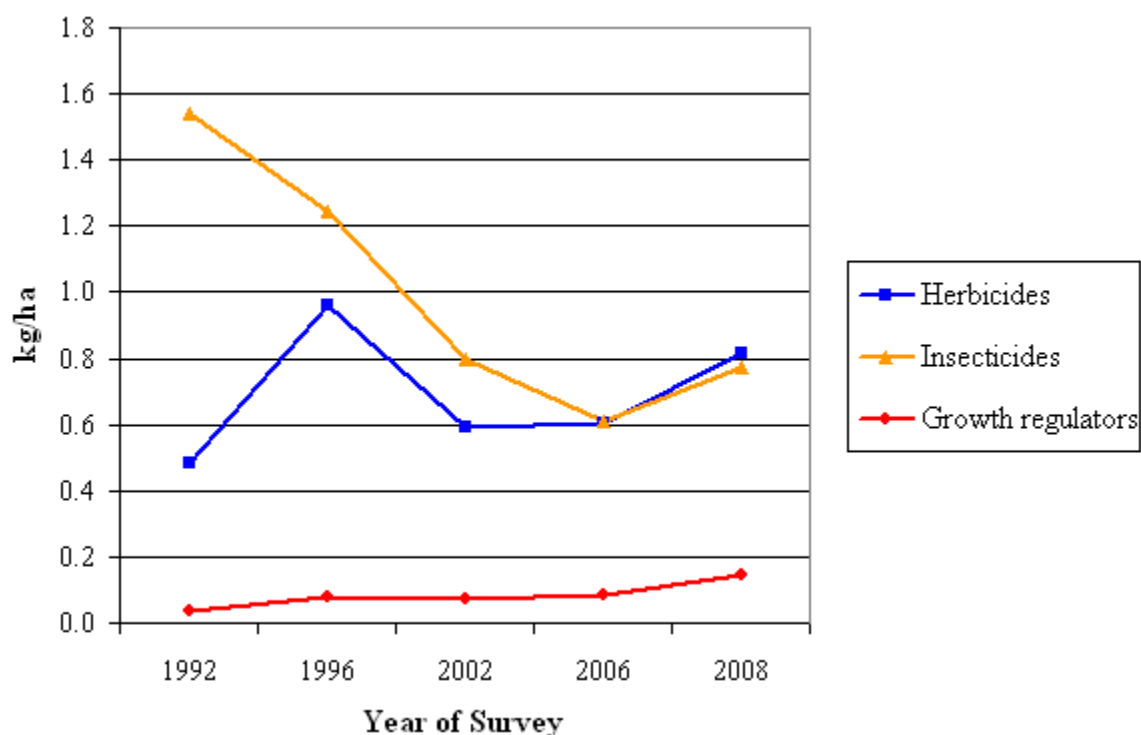


Figure 14: Proportion of stored Bramley apples treated, Northern Ireland, 2008.

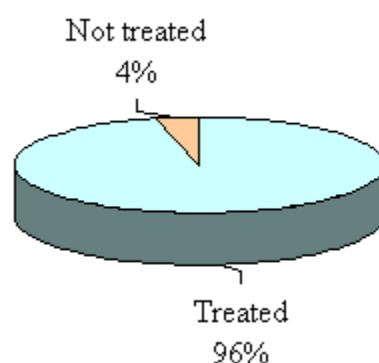


Figure 15: Storage method for Bramley apple crops, Northern Ireland, 2008.

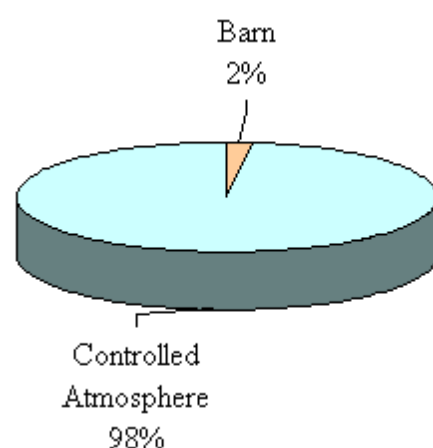


Figure 16: Comparison of apple storage and treatment, Northern Ireland, 1992-2008.

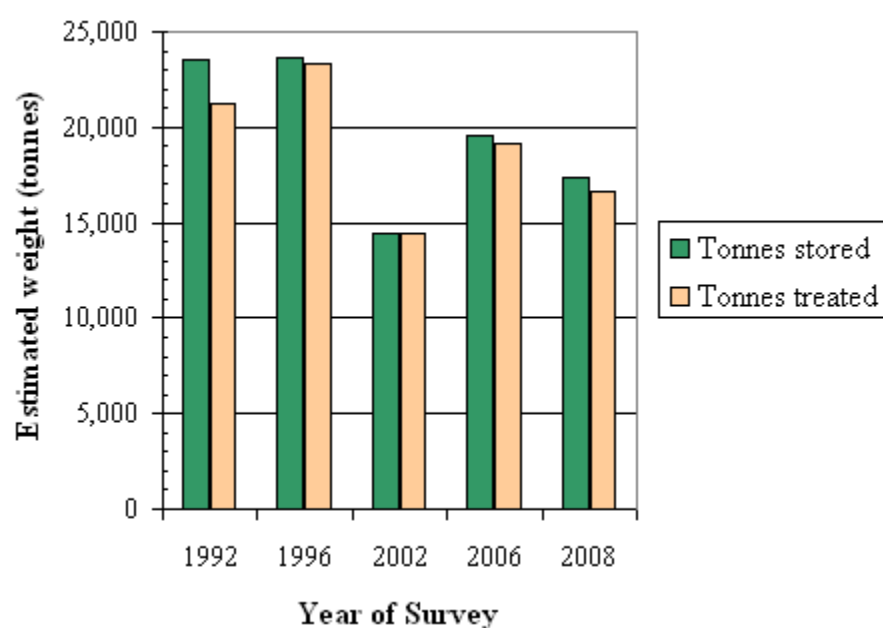


Table 1: The total number of farms in each size group with top fruit crops in 2008 and the number of holdings surveyed from each size group.

County	Size Group (hectares)												Total	
	<2		2 < 4		4 < 6		6 < 9		9+		14+			
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Antrim	.	.	.	.	.	.	1	1	.	.	.	.	1	1
Armagh	91	5	36	13	26	11	17	12	25	14	30	30	225	85
Down	18	1	1	1	20	2
Tyrone	2	1	2	2	4	3

Northern Ireland	109	6	36	13	28	12	20	14	25	14	32	32	250	91
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Legend

A = Total number of holdings in strata

B = Number of holdings surveyed

Table 2: Total number and area of crops surveyed (hectares) and the proportion (%) of the total area of top fruit crops surveyed in Northern Ireland, 2008.

Crop type	Number of crops surveyed	Surveyed area (ha)	Proportion of crop surveyed (%)
Bramley	91	1,163	79
Dessert & Plums	10	9.7	51

Table 3: Estimated area (hectares) of top fruit crops grown regionally in Northern Ireland, 2008.

Crop type	County					Northern Ireland
	Antrim	Armagh	Down	Tyrone		
Bramley	10	1,382	15	57		1,463
Dessert & Plums	.	19	.	.		19
All Crops	10	1,401	15	57		1,482

Table 4: Estimated area (spray hectares) of top fruit crops treated regionally in Northern Ireland 2008, with pesticide type.

County	Pesticide Type				Northern Ireland
	Fungicides	Herbicides	Insecticides	Growth regulators	
Antrim	114	3	10	10	137
Armagh	25,501	902	2,440	1,961	30,804
Down	312	5	23	.	340
Tyrone	1,273	55	127	96	1,550
Total	27,200	965	2,600	2,066	32,831

Table 5: Estimated quantity (kilograms) of pesticide active ingredients applied to top fruit crops regionally in Northern Ireland 2008, categorised by pesticide type.

County	Pesticide Type				Northern Ireland
	Fungicides	Herbicides	Insecticides	Growth regulators	
Antrim	132	6	1	1	140
Armagh	22,286	1,163	1,091	211	24,751
Down	191	10	15	.	216
Tyrone	945	28	39	7	1,019
All pesticides	23,554	1,206	1,146	219	26,126

Table 6: Estimated quantity (kilograms) of pesticide active ingredients applied to top fruit crops in Northern Ireland 2008 categorised by crop and pesticide type.

Crop type	Pesticide Type				Total quantity (kg)
	Fungicides	Herbicides	Insecticides	Growth regulators	
Bramley	23,342	1,198	1,140	218	25,897
Dessert & Plums	212	9	7	1	229
All Crops	23,554	1,206	1,146	219	26,126

Table 7: The total area (spray hectares) and the basic area (hectares), of top fruit crops in Northern Ireland 2008, treated with each pesticide type.

Crop type	Pesticide Type									
	Fungicides		Herbicides & desiccants		Insecticides		Growth regulators		All pesticides	
	(sp ha)	(ha)	(sp ha)	(ha)	(sp ha)	(ha)	(sp ha)	(ha)	(sp ha)	(ha)
Bramley	26,996	(1,448)	957	(424)	2,573	(1,291)	2,054	(954)	32,580	(1,448)
Dessert & Plums	204	(19)	8	(3)	27	(19)	13	(9)	251	(19)
All Crops	27,200	1,467	965	427	2,600	1,311	2,066	962	32,831	1,467

Table 8: The mean number of spray applications of pesticides applied to top fruit crops in Northern Ireland, 2008.

Crop type	Pesticide Type							
	Fungicides		Herbicides & desiccants		Insecticides		Growth regulators	
	A	B	A	B	A	B	A	B
Bramley	18.6	10.9	1.0	1.4	2.1	2.0	1.7	2.1
Dessert & Plums	16.2	7.6	1.1	1.7	1.7	1.4	1.5	1.4

Legend

A = Number of applications of pesticide type

B = Number of spray applications accounting for tank mixes

Table 9: Estimated area (spray hectares) of top fruit crops treated with pesticide formulations in Northern Ireland, 2008.

Pesticide type & information	Crop type		
	Bramley	Dessert & plums	Total area (sp ha)
Fungicides			
Boscalid/pyraclostrobin	950	2	952
Captan	2,184	34	2,218
Carbendazim	20	.	20
Copper oxychloride	467	8	474
Cyprodinil/fludioxonil	75	.	75
Difenoconazole	28	.	28
Dinocap	187	.	187
Dithianon	6,304	15	6,320
Dithianon/pyraclostrobin	247	1	248
Dodine	1,026	9	1,035
Fenbuconazole	3,524	28	3,552
Kresoxim-methyl	301	3	304
Mancozeb	5,162	78	5,240
Myclobutanil	646	3	649
Penconazole	1,467	2	1,469
Pyrifenox	22	.	22
Pyrimethanil	4,121	21	4,142
Sulphur	250	.	250
Tebuconazole	2	.	2
Tolyfluanid	14	.	14
All fungicides	26,996	204	27,200
Herbicides			
Clopyralid/fluroxypyr/triclopyr	52	.	52
2,4-D/Dichlorprop-P/MCPA/Mecoprop-P	8	.	8
Dicamba/MCPA/mecoprop-P	182	2	183
Dicamba/mecoprop-P	9	.	9
Diquat	11	1	12
Diuron	13	.	13
Glufosinate-ammonium	2	.	2
Glyphosate	606	3	609
MCPA	71	<0.5	71
Paraquat	4	1	5
All herbicides	957	8	965

Table 9 (cont): Estimated area (spray hectares) of top fruit crops treated with pesticide formulations in Northern Ireland, 2008.

Pesticide type & information	Crop type		
	Bramley	Dessert & plums	Total area (sp ha)
Insecticides			
Chlorpyrifos	1,296	9	1,305
Clofentezine	234	3	238
Cypermethrin	464	10	474
Deltamethrin	22	.	22
Fenpyroximate	8	.	8
Pirimicarb	152	<0.5	152
Tebufenpyrad	396	4	400
All insecticides	2,573	27	2,600
Growth Regulators			
Gibberellins	174	.	174
Paclobutrazol	513	2	515
Prohexadione-calcium	1,366	11	1,377
All growth regulators	2,054	13	2,066
All pesticides	32,580	251	32,831

Table 10: Estimated quantities (kilograms) of pesticide active ingredients applied to top fruit crops in Northern Ireland, 2008.

Pesticide type & information	Crop type		
	Bramley	Dessert & plums	Total quantity (Kg)
Fungicides			
Boscalid/pyraclostrobin	270	1	270
Captan	2,469	45	2,514
Carbendazim	5	.	5
Copper oxychloride	997	16	1,014
Cyprodinil/fludioxonil	15	.	15
Difenoconazole	2	.	2
Dinocap	98	.	98
Dithianon	5,837	13	5,850
Dithianon/pyraclostrobin	91	<0.5	91
Dodine	818	7	825
Fenbuconazole	206	2	207
Kresoxim-methyl	31	<0.5	31
Mancozeb	9,777	119	9,896
Myclobutanil	38	<0.5	38
Penconazole	71	<0.5	71
Pyrifenox	1	.	1
Pyrimethanil	1,607	9	1,615
Sulphur	992	.	992
Tebuconazole	<0.5	.	<0.5
Tolylfluanid	18	.	18
All fungicides	23,342	212	23,554
Herbicides			
Clopyralid/fluroxypyr/triclopyr	27	.	27
2,4-D/Dichlorprop-P/ MCPA/Mecoprop-P	10	.	10
Dicamba/MCPA/mecoprop-P	216	2	217
Dicamba/mecoprop-P	6	.	6
Diquat	3	1	4
Diuron	8	.	8
Glufosinate-ammonium	1	.	1
Glyphosate	844	5	848
MCPA	81	1	82
Paraquat	2	1	3
All herbicides	1,198	9	1,206

Table 10 (cont): Estimated quantities (kilograms) of pesticide active ingredients applied to top fruit crops in Northern Ireland, 2008.

Pesticide type & information	Bramley	Crop type	
		Dessert & plums	Total quantity (Kg)
Insecticides			
Chlorpyrifos	1,007	6	1,013
Clofentezine	46	<0.5	46
Cypermethrin	13	<0.5	13
Deltamethrin	<0.5	.	<0.5
Fenpyroximate	<0.5	.	<0.5
Pirimicarb	33	<0.5	33
Tebufenpyrad	40	<0.5	40
All insecticides	1,140	7	1,146
Growth regulators			
Gibberellins	1	.	1
Paclobutrazol	56	<0.5	57
Prohexadione-calcium	161	1	162
All growth regulators	218	1	219
Total	25,897	229	26,126

Table 11: The active ingredients most extensively used on top fruit crops in Northern Ireland 2008, ranked by treated area (spray hectares).

	Active ingredient	Treated area (sp ha)
1.	Dithianon	*6,567.7
2.	Mancozeb	5,239.7
3.	Pyrimethanil	4,141.6
4.	Fenbuconazole	3,552.0
5.	Captan	2,217.9
6.	Penconazole	1,469.4
7.	Prohexadione-calcium	1,377.2
8.	Chlorpyrifos	1,304.6
9.	Pyraclostrobin	*1,200.4
10.	Dodine	1,035.0
11.	Boscalid	*952.3
12.	Myclobutanil	648.6
13.	Glyphosate	609.2
14.	Paclobutrazol	515.2
15.	Cypermethrin	474.5
16.	Copper oxychloride	474.3
17.	Tebuufenpyrad	400.4
18.	Kresoxim-methyl	304.3
19.	MCPA	*262.6
20.	Sulphur	249.7
21.	Clofentezine	237.8
22.	Mecoprop-P	*200.3
23.	Dicamba	*192.5
24.	Dinocap	186.8
25.	Gibberellins	173.7
26.	Pirimicarb	151.9
27.	Cyprodinil	*75.2
28.	Fludioxonil	*75.2
29.	Clopyralid	*52.5
30.	Triclopyr	*52.5
31.	Fluroxypyr	*52.5
32.	Difenoconazole	28.5
33.	Deltamethrin	22.4
34.	Pyrifenoxy	21.6
35.	Carbendazim	19.6
36.	Tolylfluanid	14.4
37.	Diuron	12.9
38.	Diquat	11.9
39.	Fenpyroximate	8.2
40.	2,4-D	*7.8
41.	Dichlorprop-P	*7.8
42.	Paraquat	5.2

* Active ingredients not always sprayed as separate actives but also in formulated mixtures, as indicated by Table 9.

Table 12: The active ingredients most extensively used on top fruit crops in Northern Ireland 2008, ranked by weight (kilograms).

	Active ingredient	Quantity applied (kg)
1.	Mancozeb	9,895.6
2.	Dithianon	*5,873.3
3.	Captan	2,513.9
4.	Pyrimethanil	1,615.4
5.	Copper oxychloride	1,013.5
6.	Chlorpyrifos	1,013.1
7.	Sulphur	992.1
8.	Glyphosate	848.2
9.	Dodine	825.3
10.	MCPA	*253.2
11.	Fenbuconazole	*207.0
12.	Boscalid	*179.1
13.	Prohexadione-calcium	161.7
14.	Pyraclostrobin	*159.3
15.	Dinocap	98.0
16.	Penconazole	70.6
17.	Paclobutrazol	56.6
18.	Clofentezine	46.5
19.	Mecoprop-P	*44.8
20.	Tebuufenpyrad	40.0
21.	Myclobutanil	37.8
22.	Pirimicarb	33.0
23.	Kresoxim-methyl	31.3
24.	Tolylfluanid	18.1
25.	Cypermethrin	13.2
26.	Dicamba	12.9
27.	Triclopyr	12.0
28.	Cyprodinil	*9.2
29.	Fluroxypyr	*9.0
30.	Diuron	8.0
31.	Fludioxonil	*6.1
32.	Clopyralid	*6.0
33.	Carbendazim	4.9
34.	Diquat	3.8
35.	Paraquat	3.1
36.	Dichlorprop-P	*2.9
37.	Difenoconazole	2.5
38.	2,4-D	*1.5
39.	Glufosinate-ammonium	1.2
40.	Pyrifenox	0.9
41.	Gibberellins	0.6
42.	Fenpyroximate	0.4

* Active ingredients not always sprayed as separate actives but also in formulated mixtures, as indicated by Table 9.

Table 13: Bramley apples: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	Apple scab	Canker	Clean trees	Disease prevention	Powdery mildew & scab	Storage aid	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Fungicides									
Boscalid/pyraclostrobin	104	124	.	.	520	201	950	497	270
Captan	2,179	.	.	.	.	6	2,184	765	2,469
Carbendazim	.	.	.	.	20	.	20	10	5
Copper oxychloride	24	319	40	84	.	.	467	235	997
Cyprodinil/fludioxonil	12	.	.	.	.	63	75	54	15
Difenoconazole	28	.	.	.	.	.	28	7	2
Dinocap	.	.	.	.	187	.	187	37	98
Dithianon	6,304	.	.	.	.	.	6,304	1,171	5,837
Dithianon/pyraclostrobin	247	.	.	.	.	.	247	198	91
Dodine	1,026	.	.	.	.	.	1,026	543	818
Fenbuconazole	511	.	.	10	3,003	.	3,524	843	206
Kresoxim-methyl	.	.	.	.	301	.	301	187	31
Mancoze	4,532	.	.	.	630	.	5,162	1,058	9,777
Myclobutanil	318	.	.	.	328	.	646	332	38
Penconazole	135	.	.	.	1,332	.	1,467	475	71
Pyrifenox	22	.	.	.	.	.	22	7	1
Pyrimethanil	4,121	.	.	.	.	.	4,121	1,160	1,607
Sulphur	.	.	.	37	175	38	250	132	992
Tebuconazole	.	2	.	.	.	.	2	2	<0.5
Tolyfluanid	14	.	.	.	.	.	14	7	18
All fungicides	19,578	445	40	131	6,495	308	26,996	*1,467	23,342

* As in Table 7 rather than the sum of the above

Note 'Clean trees' refers to a winter wash applied to remove any lichens, dormant spores etc. on the trees.

Table 13 (cont): Bramley apples: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	General weed control	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Herbicides and Desiccants				
Clopyralid/fluroxypyr/triclopyr	52	52	31	27
2,4-D/Dichlorprop-P/ MCPA/mecoprop-P	8	8	8	10
Dicamba/MCPA/mecoprop-P	182	182	122	216
Dicamba/mecoprop-P	9	9	6	6
Diquat	11	11	7	3
Diuron	13	13	13	8
Glufosinate-ammonium	2	2	1	1
Glyphosate	606	606	419	844
MCPA	71	71	53	81
Paraquat	4	4	4	2
All herbicides	957	957	*427	1,198

Table 13 (cont): Bramley apples: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	Growth regulation	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Growth regulators				
Gibberellins	174	174	82	1
Paclobutrazol	513	513	204	56
Prohexadione-calcium	1,366	1,366	848	161
All growth regulators	2,054	2,054	*962	218

* As in Table 7 rather than the sum of the above

Table 13 (cont): Bramley apples: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	Aphids	Capsid	Insect control	Red spider mite	Tortrix moth	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Insecticides								
Chlorpyrifos	368	22	893	.	13	1,296	900	1,007
Clofentezine	.	.	.	234	.	234	234	46
Cypermethrin	28	.	436	.	.	464	408	13
Deltamethrin	10	.	12	.	.	22	17	<0.5
Fenpyroximate	.	.	.	8	.	8	8	<0.5
Pirimicarb	137	.	14	.	.	152	117	33
Tebufenpyrad	.	.	7	389	.	396	391	40
All insecticides	543	22	1,362	632	13	2,573	*1,311	1,140

* As in Table 7 rather than the sum of the above

Table 14: Dessert apples & Plums: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	Apple scab	Clean trees	Disease prevention	Powdery mildew & scab	Storage aid	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Fungicides								
Boscalid/pyraclostrobin	<0.5	.	.	1	2	2	2	1
Captan	34	.	.	.	.	34	9	45
Copper oxychloride	2	5	1	.	.	8	5	16
Dithianon	15	.	.	.	.	15	9	13
Dithianon/pyraclostrobin	1	.	.	.	.	1	1	<0.5
Dodine	9	.	.	.	.	9	4	7
Fenbuconazole	4	.	.	25	.	28	13	2
Kresoxim-methyl	.	.	.	3	.	3	2	<0.5
Mancozeb	71	.	.	7	.	78	18	119
Myclobutanil	.	.	.	3	.	3	2	<0.5
Penconazole	.	.	.	2	.	2	1	0
Pirimethanil	21	.	.	.	.	21	10	9
All fungicides	156	5	1	40	2	204	*19	212

Table 14 (contd.): Dessert apples & Plums: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	Growth regulation	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Growth Regulators				
Paclobutrazol	2	2	2	<0.5
Prohexadione-calcium	11	11	9	1
All growth regulators	13	13	*9	1

* As in Table 7 rather than the sum of the above.

Table 14 (cont): Dessert apples & Plums: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	General weed control	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Herbicides				
Dicamba/MCPA/mecoprop-P	2	2	1	2
Diquat	1	1	1	1
Glyphosate	3	3	2	5
MCPA	1	1	1	1
Paraquat	1	1	1	1
All herbicides	8	8	*3	9

Table 14 (cont): Dessert apples & Plums: pesticide-treated area (spray hectares), basic area treated (hectares), quantities used (kilograms) and reasons for use.

Pesticide type and formulation	Aphids	Insect control	Red spider mite	Total area treated (sp ha)	Basic area treated (ha)	Total quantity applied (kg)
Insecticides						
Chlorpyrifos	4	5	.	9	7.1	6
Clofentezine	.	.	3	3	3.3	<0.5
Cypermethrin	2	9	.	11	10.50	<0.5
Pirimicarb	<0.5	.	.	<0.5	<0.5	<0.5
Tebuufenpyrad	.	2	2	4	4.3	<0.5
All insecticides	6	16	5	27	*19	7

* As in Table 7 rather than the sum of the above

Table 15: All Crops: Estimated area treated (spray hectares) and quantity of other formulations applied (kilograms) to top fruit crops 2008.

Formulation	Bramley apples		Crop type Dessert apples & Plums		Total	
	sp ha	kg	sp ha	kg	sp ha	kg
Boron	890	224	1	<0.5	892	224
Calcium	1,481	1,858	15	16	1,496	1,873
Calcium chloride	323	699	.	.	323	699
Calcium/nitrogen	435	733	.	.	435	733
Calcium/nitrogen/phosphate	1,723	5,968	2	4	1,725	5,972
Copper sulphate	106	850	.	.	106	850
Magnesium sulphate	255	315	<0.4	<0.5	255	315
Magnesium/phosphate/potassium oxide	8	31	.	.	8	31
Manganese	182	87	.	.	182	87
Nitrogen	222	281	.	.	222	281
Nitrogen/phosphate/potassium oxide	1,362	2,112	12	11	1,374	2,124
Nitrogen/phosphoric acid	236	751	.	.	236	751
Nitrogen/phosphorus pentoxide/potassium oxide	1,148	502	.	.	1,148	502
Nitrogen/potassium oxide	38	44	.	.	38	44
Seaweed extract	4,737	8,878	28	60	4,765	8,938
Trace elements	129	344	.	.	129	344
Zinc	503	385	4	3	507	388
Total	13,779	24,062	63	95	13,841	24,157

Table 16: Comparison of the area of apple crops grown (hectares) in Northern Ireland, 1992-2008.

Crop type	Survey year					% change in area 2008/2006
	1992 (ha)	1996 (ha)	2002 (ha)	2006 (ha)	2008 (ha)	
Bramley apples						
Bramley apples (fruiting)	1,574	1,511	1,265	1,341	1,463	9%
Bramley apples (non-fruiting)	158	189	197	74	0	-100%
All Bramley apples	1,732	1,701	1,462	1,415	1,463	3%
Dessert apples (and Plums*)						
Dessert apples (fruiting)	57	13	20	21	19*	-10%
Dessert apples (non-fruiting)	5	0.4	4	14	0	-100%
All dessert apples	62	13	24	35	19	-46%
Total apple crops	1,794	1,714	1,486	1,450	1,482	2%

* **Note:** In 2008 the dessert apples and plums were recorded together.

Table 17a: Comparison of pesticide usage on top fruit crops in Northern Ireland 1992-2008, area treated (spray hectares) and the weight applied (kilograms).

Pesticide type	Survey year									
	1992		1996		2002		2006		2008	
	Area (sp ha)	Quantity (Kg)	Area (sp ha)	Quantity (Kg)	Area (sp ha)	Quantity (Kg)	Area (sp ha)	Quantity (Kg)	Area (sp ha)	Quantity (Kg)
Fungicides	20,272	13,549	21,620	20,672	23,473	26,756	24,836	20,132	27,200	23,554
Herbicides	761	865	1,190	1,652	1,000	881	899	875	965	1,206
Insecticides & acaricides										
Carbamates	33	56	32	7	88	10	104	17	152	33
Organochlorines	153	101	30	19	.	.	.	.	.	.
Organophosphates	2,357	1,733	2,239	1,870	1,373	996	1,129	811	1,305	1,016
Pyrethroids	586	13	464	16	481	18	595	18	496	23
Acaricides	112	31	751	157	201	24	301	24	645	93
Biopesticides	.	.	.	.	.	.	13	2	.	.
Other insecticides	524	465	182	60	115	139	47	6	.	.
All insecticides & acaricides	3,765	2,399	3,698	2,129	2,258	1,186	2,189	878	2,598	1,165
Growth regulators	134	69	713	137	610	107	990	126	2,066	219
Mixed activity a.i.'s	11	73	17	14	.	.	.	.	.	.
All pesticides	24,943	16,955	27,238	24,604	27,341	28,930	28,914	22,011	32,831	26,125

Table 17b: Comparison of application ratios of the active ingredients most extensively used on top fruit crops in Northern Ireland, 1992-2008.

		2008	2006	2002	1996	1992
	Active ingredient	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)
1.	Mancozeb	6.677	7.219	11.383	5.893	2.168
2.	Dithianon	3.963	2.471	3.307	2.387	1.401
3.	Captan	1.696	1.362	1.286	1.927	1.854
4.	Pyrimethanil	1.090	0.558	0.344	0.003	.
5.	Copper oxychloride	0.684	0.401	0.733	0.424	0.677
6.	Chlorpyrifos	0.684	0.560	0.400	0.311	0.329
7.	Sulphur	0.669	0.059	0.174	0.001	.
8.	Glyphosate	0.572	0.340	0.296	0.447	0.148
9.	Dodine	0.557	0.722	0.259	0.483	0.121
10.	MCPA	0.171	0.141	0.104	0.078	0.029
11.	Fenbuconazole	0.140	0.102	0.118	0.021	.
12.	Boscalid	0.121	0.031	.	.	.
13.	Prohexadione-calcium	0.109	0.026	.	.	.
14.	Pyraclostrobin	0.108	0.016	.	.	.
15.	Dinocap	0.066	.	.	.	.
16.	Penconazole	0.048	0.031	0.043	0.127	0.091
17.	Paclobutrazol	0.038	0.060	.	0.079	0.007
18.	Clofentezine	0.031	0.002	0.004	0.057	0.009
19.	Mecoprop-P	0.030	0.073	0.013	.	.
20.	Tebuufenpyrad	0.027	0.013	0.011	0.019	.
21.	Myclobutanil	0.025	0.032	0.014	0.092	0.275
22.	Pirimicarb	0.022	0.009	0.007	0.004	.
23.	Kresoxim-methyl	0.021	0.027	.	.	.
24.	Tolylfluanid	0.012	0.337	.	.	.
25.	Cypermethrin	0.009	0.012	0.009	0.006	.
26.	Dicamba	0.009	0.012	0.006	0.017	0.011
27.	Triclopyr	0.008	0.002	0.012	0.021	0.017
28.	Cyprodinil	0.006	.	.	.	.
29.	Fluroxypyr	0.006	.	.	.	.
30.	Diuron	0.005	0.012	.	0.035	.
31.	Fludioxonil	0.004	.	.	.	.
32.	Clopyralid	0.004	.	.	.	.
33.	Carbendazim	0.003	0.559	0.756	0.407	0.252

Table 17b (contd): Comparison of application ratios of the active ingredients most extensively used on top fruit crops in Northern Ireland, 1992-2008.

		2008	2006	2002	1996	1992
	Active ingredient	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)	Quantity per unit of basic crop area (kg/ha)
34.	Diquat	0.003	.	.	.	.
35.	Paraquat	0.002	0.011	.	0.120	0.069
36.	Dichlorprop-P	0.002	.	.	.	.
37.	Difenoconazole	0.002	.	0.006	.	.
38.	2,4-D	0.001	.	0.073	0.007	.
39.	Glufosinate-ammonium	0.001	.	0.003	0.002	0.007
40.	Pyrifeno	0.001	.	0.029	0.042	0.021
41.	Gibberellins	0.000	0.000	.	.	.
42.	Fenpyroximate	0.000	0.001	0.001	.	.

Note: Shows history of active ingredients found in 2008 survey only

Table 18: Estimated quantities (tonnes) of apples in storage in Northern Ireland 2008 receiving treatment and the total weight of active ingredients applied (kg).

Pesticide formulation	Total quantity (t)	Total quantity applied (kg)
Fungicides		
Cyprodinil/fludioxonil	214	99
All fungicides	214	99
Antioxidant		
Diphenylamine	16,630	435
All antioxidants	16,630	435
Other products		
Calcium	1,093	23
All other products	1,093	23
All treatments	17,937	557

Table 19: The active ingredients used in apple storage in Northern Ireland 2008, ranked by weight (kilograms).

Active ingredient	Quantity used (kg)
Diphenylamine	435
Cyprodinil/fludioxonil	99
Calcium	23

Table 20: Estimated quantities (treated tonnes) of Bramley fruiting apples in storage in Northern Ireland 2008, receiving treatment and reason for use.

Active ingredient	Bitter pit	Storage aid	Storage rots	Total quantity applied (kg)
Calcium	1,093	.	.	1,093
Cyprodinil/fludioxonil	.	.	214	214
Diphenylamine	.	16,630	.	16,630
All treatments	1,093	16,630	214	17,937

Note: Only Bramley fruiting apples were stored in Northern Ireland, 2008.

Table 21: Comparison of the estimated quantities (tonnes) of fruit receiving treatment and the total weight of active ingredients applied (kg) to Bramley apples in storage 1992-2008.

Pesticide formulation	Survey Year									
	1992	1992	1996	1996	2002	2002	2006	2006	2008	2008
	Total quantity (t)	Total quantity applied (kg)	Total quantity (t)	Total quantity applied (kg)	Total quantity (t)	Total quantity applied (kg)	Total quantity (t)	Total quantity applied (kg)	Total quantity (t)	Total quantity applied (kg)
Antioxidants										
Diphenylamine	2,154	71	10,496	611	7,778	195	13,216	307	16,630	435
Ethoxyquin	8,350	378	1,381	50	750	15	.	.	.	.
All antioxidants	10,504	449	11,877	661	8,528	210	13,216	307	16,630	435
Fungicides										
Benomyl	4,166	124	.	.	385	4	332	2	.	.
Carbendazim	1,789	39	6,372	87	5,384	44	830	4	.	.
Carbendazim/metalaxyl	4,299	115	3,901	90	.	.	.	.	.	.
Captan	.	.	.	.	117	64	477	195	.	.
Cyprodinil/fludioxonil	.	.	.	.	.	.	.	.	214	99
Thiophanate-methyl	436	5	1,146	40	.	.	129	1	.	.
Metalaxyl-M	.	.	.	.	.	.	4,207	5	.	.
All fungicides	10,690	283	11,419	217	5,886	112	5,975	207	214	99
All treatments	21,194	732	23,296	878	14,414	322	19,191	514	16,844	534
<i>Not treated</i>	<i>2,322</i>	<i>.</i>	<i>384</i>	<i>.</i>	<i>17</i>	<i>.</i>	<i>408</i>	<i>.</i>	<i>689</i>	<i>.</i>

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