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PESTICIDE USAGE IN NORTHERN IRELAND

SURVEY REPORT 198

Grassland and Fodder Crops

2003

Agriculture, Fishing & Forestry

A National Statistics Publication

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NORTHERN IRELAND
GRASSLAND AND FODDER CROPS

2003

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The County Regions Of Northern Ireland

SUMMARY

This is the fourth survey examining pesticide usage practices on grassland and fodder crops in Northern Ireland, providing data comparative to that obtained from previous surveys in 1989 (Jess *et al.*, 1992), 1993 (Jess *et al.*, 1995) and 1997 (Jess *et al.*, 2000). In this survey information on all aspects of pesticide usage was collected from 307 farms throughout the Province, representing 2% of the total area of grassland and fodder crops grown. Quantitative data obtained were adjusted to provide estimates of total pesticide usage.

Overall, the area of grassland and fodder crops grown in 2003 increased by 14%, 26% and 3% when compared to that recorded in 1989, 1993 and 1997, respectively. The area of established grassland crops was similar to that grown in 1997 but had increased by 14% and 22% when compared to both 1989 and 1993, respectively. In 2003, the area of sown crops was similar to that grown in 1989, representing more than a three-fold increase compared to 1993 and two-fold increase compared to 1997. The area of fodder crops grown in Northern Ireland in 2003 increased four-fold since 1997. This was principally due to the significant increase in fodder maize production.

The area of grassland and fodder crops receiving pesticide treatment increased by 62%, 95% and 48% when compared to that recorded in 1989, 1993 and 1997, respectively. A total of 103 tonnes of pesticides was applied to 178,149 spray hectares of grassland and fodder crops during 2003. This represented a 39% reduction in the weight of pesticides applied compared to 1997. Herbicides accounted for 84% of the pesticide-treated area, representing 95% of the weight of pesticides applied. Seed treatments accounted for a further 10% of the treated area. The weight of seed treatment active ingredients applied represented less than 1% of the total active ingredients. Fungicides, insecticides and growth regulators collectively accounted for the remainder of the total pesticide usage. No molluscicide use was recorded during this survey.

The areas of enclosed grazing and grass silage treated with pesticides increased when compared to previous surveys. However, the weight of pesticide used in these areas decreased to levels similar to those recorded in 1989. Pesticide usage on sown grassland crops increased significantly when compared with 1993 and 1997. In contrast, the area treated in 2003 was 14% lower than that recorded in 1989 and the weight of pesticides applied declined by 29% during this period. There was a significant increase in pesticide usage on fodder crops in 2003, especially when compared to 1993.

Herbicides remained the most extensively used pesticide type on grassland and fodder crops. Overall, applications of herbicides increased when compared with 1989, 1993 and 1997. However, the weight of herbicides applied reduced by 19%, 27% and 42%, respectively. The formulation of fluroxypyr/triclopyr was the most frequently used herbicide, principally applied to the first-cut of grass silage. The main reason given for herbicide applications was to control docks (*Rumex* spp.).

A total of seventy products comprising forty five active ingredients was recorded in use in this survey.

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. This is measured in ‘spray-hectares’.
- ‘Reasons for use’ refers to the perceived reasons reported by the farmer for the use of a particular pesticide. These reasons may sometimes be inappropriate.
- ‘Rounding’ due to rounding of figures there may be slight differences in totals both within and between tables.
- ‘Spray applications’ refers to the number of treatments by any pesticide type to the treated areas.
- ‘Grass silage’ prior to 1997, the survey areas of grass silage from multiple cuts were reported as a single crop. However, in keeping with 1997 the 2003 survey areas and pesticide treatments on individual cuts of silage were recorded separately.
- ‘Rough grazing’ may be defined as land containing semi-natural vegetation including heathland, heather moorland, bog and rough grassland suitable only for use as grazing.
- ‘Enclosed grazing’ may be defined as land which has been improved by management practices such as liming, top dressing and fencing etc., where there is not a significant presence of sensitive plant species, and could be cultivated for other purposes.
- ‘Arable silage’ may be defined as arable crops which have been ensiled and have not been combined for grain.
- ‘Arable silage (undersown)’ may be defined as arable crops grown as a nurse crop for a green cover crop, such as ryegrass, and have been ensiled and not combined for grain.
- ‘Cereals (undersown)’ may be defined as arable crops grown as a nurse crop for a green cover crop, such as ryegrass, which have been combined for grain.

INTRODUCTION

As a participant of the UK Working Party on Pesticide Usage Surveys, the Department of Agriculture and Rural Development (DARD), conducts a cyclical 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. However, pesticide usage data may also be used by those involved in residue testing, for public information, provision of data for research and evaluation of trends in pesticide usage.

This is the fourth survey of pesticide usage on grassland and fodder crops in Northern Ireland. The previous surveys of this sector were conducted in 1989 (Jess *et al.*, 1992), 1993 (Jess *et al.*, 1995) and 1997 (Jess *et al.*, 2000), data from which are included in this report for comparative purposes.

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

METHODS

The sample of holdings to be surveyed was selected from each of the six counties, on the basis of the total area of grassland and fodder crops grown, using data from the Northern Ireland Agricultural Census, June 2002 (Anon., 2003). This comprised the areas grown of established grassland crops and sown grassland and fodder crops.

In each region the sample holdings were stratified into six size groups according to the total area of grassland and fodder crops grown. Holdings were selected at random from within each of the size groups, the number of holdings being proportional to the total area of grassland and fodder crops grown.

The purpose of the survey was explained to the occupiers of selected holdings in preliminary correspondence. A total of 307 holdings were surveyed from October 2003 to March 2004. A majority of the data was collected by telephone interview, but a minimal number were collected by personal interview. The data collected included; the area of crops grown, area treated, the target crop, pesticides used and the number of treatments applied. The growers' perceived reasons for pesticide use, including inappropriate usage, were also recorded. Holdings selected in the original sample which proved unable to provide data were replaced

with those from the same county and size group held on a reserve list. During analysis, the sample data were raised to the total population level using raising factors calculated from the ratio of the number of farms sampled to the number of farms in the population within each region and size group. A further adjustment factor corrected the data in accordance with the areas of grassland and fodder crops published in the Northern Ireland Agricultural Census, June 2003 (Anon., 2004). The total number of farms in each size group and the number of farms sampled are shown in Table 1.

The collected data were entered using Oracle, a relational database programme. Validated data were downloaded for analysis using SPSS software.

RESULTS AND DISCUSSION

CROPS

Information collected from 307 farms provided data concerning 1,238 examples of fourteen grassland and fodder crop types (Table 2). The area surveyed represented approximately 2% of the total area of grassland and fodder crops grown in Northern Ireland in 2003. Areas of grassland and fodder crops grown in the six counties were estimated using raising factors discussed earlier (Table 3, Figure 1). Collectively, Counties Antrim and Tyrone accounted for approximately 48% of the area of grassland and fodder crops grown, with Counties Down and Londonderry together accounting for a further 30%. Counties Fermanagh and Armagh accounted for 12% and 10%, respectively.

Land used for enclosed and rough grazing represented 45% and 14% of the total area of grassland and fodder crops, respectively (Table 3, Figure 2). The area assigned to first-cut silage production was 23% with total silage production accounting for 36% of the grassland and fodder crop area. The area for hay production represented a further 1% of the total area of grassland and fodder crops. Reseeds, comprising arable silage (both undersown and non-undersown), undersown cereals and grass reseeds, collectively accounted for 4% of the total area of grassland and fodder crops. Fodder crops, including small areas of fodder kale, maize, rape and turnip, accounted for less than 1% of the total area of grassland and fodder crops.

REGIONAL PESTICIDE USAGE

County Antrim represented 23% and 27% of the pesticide-treated area and weight applied, respectively, and County Tyrone 24% of both the pesticide-treated area and the total weight of pesticides used on grassland and fodder crops (Tables 4 & 5). Approximately 46% of all herbicide applications were recorded in Counties Antrim and Tyrone. Fungicides, herbicides and seed treatments were recorded in County Down, accounting for 17% of the pesticide-treated area and 18% of the weight of pesticides applied. County Armagh represented 15% of the pesticide-treated area and 17% of the weight pesticides applied. County Londonderry recorded 15% of the total land used for both established grassland and sown crops along with 9% of fodder crops. This county represented 11% of both pesticide-treated area and weight of pesticides applied to grassland and fodder crops. County Fermanagh recorded 12% of the total land used for grassland and fodder crops, accounting for 11% of the total pesticide-treated area and 3% of the total weight of pesticide applied (Tables 4 & 5, Figure 3).

PESTICIDE USAGE ON CROPS

Established grassland crops represented 71% and 76% of the pesticide-treated area and weight of active ingredients applied to grassland and fodder crops in Northern Ireland in 2003, respectively (Tables 6 & 7). Sown crops, including arable silage, reseeds and fodder crops, accounted for the remaining 29% and 24% of the pesticide-treated area and weight of pesticides applied, respectively. Grassland, used for enclosed grazing or silage production, including grass and arable, represented 96% of the total treated area of grassland and fodder crops and 97% of the total weight of pesticides applied. A majority of crop types received herbicide treatment, with the exceptions of fodder kale, rape and turnip. The use of fungicides was confined to arable crops and fodder kale. Seed treatments were applied to all sown crops with exception of fodder turnip. Fodder turnips received no applications of any pesticide type. Grassland used for rough grazing represented only 1% of the total pesticide-treated area (Tables 6 & 7).

PROPORTION OF CROPS TREATED

The proportion of each crop treated with the different pesticide groups and the number of pesticide applications to each crop type is shown in Table 8. Approximately 9% of the total area of grassland and fodder crops grown in 2003 received at least a single treatment with

pesticides. Generally, pesticide application was confined to seed treatment and a single herbicide application. More than 13% of the area assigned for first-cut grass silage production received herbicide treatments. However, 9% and 4% of the areas assigned for subsequent silage cuts received herbicides, respectively. The total area of arable silage received on average 1.3 applications of herbicides and 98% received a pesticide application. It was estimated that all maize crops received herbicide and 92% were sown with treated seed. Fungicides were applied to 25% of arable silage crops. All fodder kale crops received applications of both fungicide and insecticide with 100% of fodder rape crops sown with treated seed.

TOTAL PESTICIDE USAGE

An estimated total of 102.6 tonnes of pesticides were applied to 178,148 spray hectares of grassland and fodder crops during 2003 (Tables 9 & 10). Herbicides accounted for 84% of the pesticide-treated area and represented 96% of the weight of pesticides applied. Seed treatments accounted for a further 10% of the treated area. The weight of seed treatment active ingredients applied represented less than 1% of the total active ingredients used. Fungicides, insecticides and growth regulators collectively accounted for the remainder of the total pesticide usage. No molluscicides were recorded in use during the survey period.

Fungicides were recorded in use on sown crops and fodder kale. The most extensively used fungicide was the active ingredient tebuconazole, used primarily on both undersown and non-undersown arable silage.

Grassland used for silage production and enclosed grazing accounted for 82% of the total area of herbicide applications. The most extensively used herbicide formulation on grassland and fodder crops was fluroxypyr/triclopyr, accounting for 29% of the herbicide-treated area. The herbicide most frequently used on fodder crops was the triazine herbicide atrazine, accounting for 51% of the herbicide-treated area of fodder crops. Atrazine was used extensively on fodder maize.

Cypermethrin and chlorpyrifos were the only insecticide active ingredients recorded. Cypermethrin was applied to arable silage and undersown cereals to control aphids and chlorpyifos applied to fodder kale and grass reseeds to control caterpillars and leatherjackets (*Tipula spp.*), respectively.

The single active ingredient chlormequat was the only growth regulator recorded and was applied to undersown and non-undersown arable silage.

Arable silage accounted for 68% of the grassland and fodder crops sown with treated seed. The remainder comprised of fodder maize (23%), undersown cereals (8%) and fodder rape (1%). The seed treatment fludioxonil applied either as a single active ingredient, or in formulation with metalalaxyl-M, accounted for approximately 77% of the total area sown with treated seed.

The thirty active ingredients recorded in use on grassland and fodder crops, ranked by spray area and weight applied, are shown in Tables 11 and 12, respectively. The top ten active ingredients in each category were herbicides including triclopyr, fluroxpyr, glyphosate, MCPA, mecoprop, mecoprop-P, and dicamba.

PESTICIDE USAGE ON ESTABLISHED GRASSLAND CROPS

Enclosed grazing (Table 13)

Herbicides were the only pesticide applied to enclosed grazing areas. Dock (*Rumex* spp.) and rush (*Juncus* spp.) control accounted for 41% and 33% of the herbicide application to this crop, respectively. Twelve herbicides were used to control docks with approximately 37% of applications using the formulation fluroxypyr/triclopyr. The single active ingredient glyphosate was most extensively used for the control of rushes (*Juncus* spp.). A formulation of dicamba/MCPA/mecoprop-P was primarily applied to control chickweed (*Stellaria media*).

Grass silage first cutting (Table 14)

An estimated 273,119 hectares of first-cut grass silage were grown in Northern Ireland in 2003 with County Tyrone accounting for 27% (Table 3). Approximately 14% of land allocated to the first cutting of grass silage received a single application of pesticide. Herbicides were the only pesticide group applied to this area and the control of docks (*Rumex* spp.) accounted for 73% of the area of application. The formulation fluroxypyr/triclopyr was most extensively used for this purpose.

Grass silage second cutting (Table 15)

The area of grassland allocated for second cutting of grass silage was estimated to be 150,093 hectares, representing 55% of that in the first cut (Table 3). Herbicides were the only pesticide applied to grassland areas in the interval between the first and second cutting of grass silage. Dock (*Rumex* spp.) control accounted for 75% of herbicide applications. Approximately 9% of herbicide applications were to control chickweed (*Stellaria media*). The formulation fluroxypyr/triclopyr was the most extensively used herbicide formulation providing 53% of all herbicide applications to this crop type.

Grass silage third cutting (Table 16)

Approximately 5% of ground allocated for second cut grass silage production was cut on a third occasion, totalling 7,330 hectares (Table 3). Three different herbicide formulations were used to treat 400 spray hectares to control docks (*Rumex spp.*).

Hay (Table 17)

An estimated 11,997 hectares were allocated to hay production in Northern Ireland in 2003 (Table 3). Approximately 2% of this crop received a single application of herbicide, the only pesticide group applied to this crop type. Dicamba/MCPA/mecoprop-P, used to control docks (*Rumex* spp.), was the most extensively used herbicide formulation on hay crops accounting for 94% of the herbicide-treated area and 99% of the weight of herbicides used.

Rough grazing (Table 18)

Less than 1% of the rough grazing area received herbicide treatment, the only pesticide group applied to this crop type (Table 8). Control of rushes (*Juncus* spp.), was the principal reason given for pesticide application, accounting for 61% of the treated area. MCPA was the most frequently used herbicide active ingredient for this purpose. The formulation fluroxypyr/triclopyr was specified as the most frequently used herbicide applied to control docks (*Rumex spp.*) representing 19% of the total area of rough grazing treated.

PESTICIDE USAGE ON SOWN CROPS

Arable silage (Table 19)

Approximately 8,720 hectares of arable silage were grown in Northern Ireland in 2003 (Table 3). An estimated 50% was grown in County Armagh. Applications of herbicides and desiccants to arable silage accounted for 39% of the pesticide-treated area (75% of the weight of pesticide applied), seed treatments 37% (2%), fungicides 16% (10%), growth regulators 7% (13%) and insecticides 2% (<1%) (Tables 9 & 10).

The specified herbicide most extensively used was metsulfuron-methyl, applied generally as a single active ingredient, but also in formulation with tribenuron-methyl. This was used primarily for ‘general weed control’. Because of its low application rate per hectare, the weight of metsulfuron-methyl used represented <1% of the weight of herbicide active ingredients applied to arable silage, while accounting for 27% of the herbicide-treated area.

The systemic conazole fungicide tebuconazole, used generally as a single active ingredient but occasionally in formulation with triadimenol, was the most extensively used fungicide accounting for both 32% of the fungicide-treated area and weight applied.

Cypermethrin and chlormequat were used to control aphids and for growth regulation, respectively.

Approximately 93% of the arable silage area was sown with treated seed (Table 8). Fludioxonil was the most extensively used seed treatment representing 88% of the area sown with treated seed and 30% of the weight of seed treatment active ingredients applied (Table 9 & 10).

Arable silage (undersown) (Table 20)

Herbicides accounted for 35% of the pesticide-treated area of undersown arable silage (64% of the weight of pesticide applied), seed treatments 36% (1%), fungicides 26% (31%) and growth regulators 3% (4%). No insecticides were reported as applied to this crop (Tables 9 & 10).The single active ingredients metsulfuron-methyl and mecoprop-P together accounted for 62% of the herbicide-treated area, with mecoprop-P representing 55% of the weight of herbicide active ingredients used.

The single active ingredient tebuconazole, along with the formulation cyproconazole/ trifloxystrobin were the most extensively used fungicides, accounting for 75% of the fungicide-treated area and 63% of the weight applied.

Chlormequat was the only growth regulator applied.

Cereals (undersown) (Table 21)

Fungicides, herbicides, insecticides and seed treatments were applied to this crop type (Table 9 & 10). Fungicides were applied to 23% of undersown cereals for ‘general disease control’ in the cereal component of the crop. Seven active ingredients were recorded, used either individually or in formulation. Tebuconazole was the most extensively used, either as a single active ingredient, or in formulation with triadimenol, accounting for 47% of the fungicide-treated area and 43% of the weight of fungicides applied.

Herbicides were applied to 23% of undersown cereal crops. ‘General weed control’ was the reason provided for herbicide applications and the formulation benazolin/2,4-DB/MCPA was most frequently used, accounting for 51% of the herbicide-treated area. The insecticide active ingredient cypermethrin was applied to 4% of undersown cereal crops for aphid control. Approximately 34% of undersown reseeds were sown with fludioxonil-treated seed (Tables 8, 9 & 10).

Grass reseeds (Table 22)

Herbicides were generally applied as one spray application to 21% of grass reseeds (Table 8). Glyphosate, used for pre-sowing ground preparation, accounted for 74% of herbicide usage.

The insecticide chlorpyrifos was applied to 80 hectares of grass reseeds to control leatherjackets (*Tipula* spp.).

No seed treatments were applied to grass reseeds.

PESTICIDE USAGE ON FODDER CROPS

A total of 2,419 hectares of fodder crops were grown in Northern Ireland in 2003. This represented less than 1% of the total area of grassland and fodder crops grown and County Tyrone accounted for 56% of the total fodder crops grown (Table 3). This was entirely due to the production of fodder maize. No fodder crops were grown in Counties Antrim and Fermanagh. Pesticide usage on fodder crops represented approximately 4% of the pesticide-treated area and 3% of the total weight of pesticides used (Table 9 & 10).

Fodder kale (Table 23)

The growing of fodder kale was confined to 335 hectares in County Armagh, representing 14% of the total area of fodder crops sown in Northern Ireland in 2003. This compared with 45 hectares grown in 1993. One spray application each of the insecticide chlorpyrifos, to control caterpillars and the fungicide mancozeb, to control blight, were applied to the total area of this crop. No seed treatments were recorded.

Fodder maize (Table 24)

Fodder maize had not been recorded in previous surveys conducted in 1989 and 1993 and only 10 hectares was recorded in 1997. In 2003, 1,463 hectares of fodder maize were recorded with 92% occurring in County Tyrone. Pesticide usage represented 89% and 77% of the pesticide-treated area and weight of pesticides applied to fodder crops, respectively. In 2003 approximately 92% of fodder maize was sown with seed treated with the single active ingredients thiram and methiocarb along with the formulation fludioxonil/metalaxyl-M (Tables 8, 9 &10). The herbicide atrazine was applied to 1,342 spray hectares of fodder maize.

Fodder rape

In 2003, an approximate total of 157 hectares of fodder rape was grown entirely in County Down representing 6% of the area of fodder crops grown (Table 3). Fodder rape had only previously been recorded in 1997. No pesticide sprays were applied and all fodder rape was sown with seed treated with thiram.

Fodder turnip

Of the 464 hectares of fodder turnip grown in Northern Ireland in 2003, 258 hectares were grown in County Down and 206 hectares in County Londonderry.

No pesticides or seed treatments were applied to fodder turnips.

COMPARISON WITH PREVIOUS SURVEYS

Comparison of the areas of grassland and fodder crops surveyed (Table 25)

Overall, the area of grassland and fodder crops grown, increased by 14%, 26% and 3% when compared to that previously recorded in 1989, 1993 and 1997, respectively. Areas of established grassland crops were similar to those recorded in 1997 but had increased by 22% when compared with 1993 and 14% when compared with 1989. Areas of sown crops grown have increased by more than two-fold compared with 1997 and returned to levels comparable with 1989. The area of fodder crops grown in Northern Ireland in 2003 was more than four-fold that recorded in 1997.

Established grassland crops

The decline in the area of rough grazing ground recorded between 1989 and 1997 continued with a further 2% reduction observed in 2003. Similarly, the area of hay grown had declined markedly by 82%, 64% and 63% from that previously recorded in 1989, 1993 and 1997, respectively. The area of grassland used for enclosed grazing and grass silage, which had remained relatively constant between 1989 and 1993 but increased by 28% in 1997 and showed a further increase of 4% in 2003. In keeping with 1997, the areas and pesticide treatments on individual grass silage cuttings were recorded separately.

Sown crops

During 2003 in Northern Ireland the area of sown crops grown had increased from 19,830 hectares in 1997 to 46,600 hectares with all sown crops, except for undersown cereals, showing increased production. The arable silage area increased by more than eleven-fold when compared with 1997 and over two-fold when compared with 1989. No production was recorded in 1993. Undersown arable silage production increased by 97% when compared with 1997. In contrast to undersown cereal production, which remained similar to that recorded in 1997, grass reseeds increased by more than two-fold to 27,282 hectares, still well below the 35,434 hectares first recorded in 1989.

Fodder crops

Approximately 2,419 hectares of fodder crops were grown in 2003. This was a four-fold increase compared to that recorded in 1997 and was mainly due to a significant increase in fodder maize production, from 10 hectares in 1997 to 1,463 hectares in 2003. The area of fodder kale grown increased by more than seven-fold when compared with 1997. Fodder rape and fodder turnip areas increased by 59% and 86%, respectively, over the same period. Both fodder beet and undersown kale were not recorded as grown in the 2003 survey.

Comparison of pesticide usage (Table 26)

Overall, the area of grassland and fodder crops receiving pesticide treatment increased by 62%, 95% and 48% when compared to previous surveys conducted in 1989, 1993 and 1997, respectively. In contrast, the weight of pesticides used in 2003 decreased by 16%, 24% and 39% when compared to the same periods. This was due to the significant reduction of pesticides applied to established grassland crops. During 2003, 77.6 tonnes of pesticide were applied compared with 91.6 tonnes, 124.3 tonnes and 159.0 tonnes being applied in 1989, 1993 and 1997, respectively. Although the pesticide-treated area of enclosed grazing and grass silage increased by 25% during the period 1997 to 2003, the weight of pesticide applied decreased by 50%.

Pesticide usage on sown grassland crops increased significantly in 2003 when compared with previous surveys conducted in 1993 and 1997 but had decreased by 14% when compared with 1989 although the areas grown during 2003 are similar to the earlier survey. This trend was repeated with the weights of pesticide applied and a 29% decrease was observed when comparing 1989 to 2003. The pesticide-treated area of arable silage increased by approximately ten-fold and three-fold when compared with 1997 and 1989, respectively, while the weight of pesticide applied increased by six-fold and over two-fold during the same periods.

The pesticide-treated area of fodder crops increased significantly from 1,370 spray hectares in 1997 to 7,496 spray hectares in 2003. This was due to the significant increase in the production of fodder maize. The weight of pesticide applied also increased from 1.2 tonnes to 3.4 tonnes.

A comparison of usage of different pesticide types on grassland and fodder crops between 1989 and 2003, with relative differences, is shown in Tables 27 and 28. Fungicide usage increased in the four-year period 1997 to 2003. This was due to the increased area grown of both undersown and non-undersown arable silage and increased usage on undersown cereals. Propiconazole was the only fungicide active ingredient recorded in 1989, and triadimenol /tridemorph were the fungicides recorded in use in 1993. In 1997 the fungicides propiconazole/tridemorph and tebuconazole, used on undersown cereals, and mancozeb, applied to undersown fodder kale, were identified in use. However, in 2003, ten fungicides were specified as applied to undersown and non-undersown arable silage and undersown cereals. Of these, tebuconazole was the most extensively used. Mancozeb was again the only fungicide used on fodder kale.

Herbicides remained the most extensively used pesticide type on grassland and fodder crops. Overall, applications of this pesticide type increased when compared with 1989, 1993 and 1997. However, the weight applied decreased by 19%, 27% and 42% over these periods. In 2003, triclopyr and fluoxypyr replaced MCPA and mecoprop as the most frequently used herbicide active ingredients. The main reason given for herbicide applications was dock (*Rumex* spp.) control.

In 1989, chlorfenvinphos was used on fodder turnips to control cabbage root fly (*Delia radicum*) and a small area of grass undersown with cereals was treated with deltamethrin. No insecticide was recorded in use on any crop type in 1993. Insecticide usage in 1997 was minimal and restricted to 8 hectares of fodder turnips receiving treatments of γ-HCH for flea beetle control (*Phyllotreta* spp.). During 2003 insecticide application increased significantly. Cypermethrin was applied to both arable silage and undersown cereals to control aphids and chlorpyrifos was applied to fodder kale and grass reseeds to control caterpillars and leatherjackets, respectively.

Prior to 1997, growth regulators had not been recorded in use on grassland and fodder crops. However, in 1997, 2-chloroethylphosphonic acid was applied to 4% of undersown cereal crops for straw/stem length regulation. Applications of growth regulators have increased significantly in 2003. Chlormequat was the only growth regulator recorded as used in 2003 and was applied to 1,615 spray hectares of arable silage and 255 spray hectares of undersown arable silage.

The area of crops sown with treated seed increased by 75% when compared with 1997 and was approximately three-fold greater than 1993. However, this was 50% less than first recorded in 1989. The weight of seed treatment applied in 2003 showed a 42% decrease when compared to 1997 and a 72% decrease to that recorded in 1989. In contrast, a more than three-fold increase was observed in comparison to seed treatments in 1993.

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Figure 1 The proportional distribution of grassland and fodder crops grown regionally in Northern Ireland in 2003.

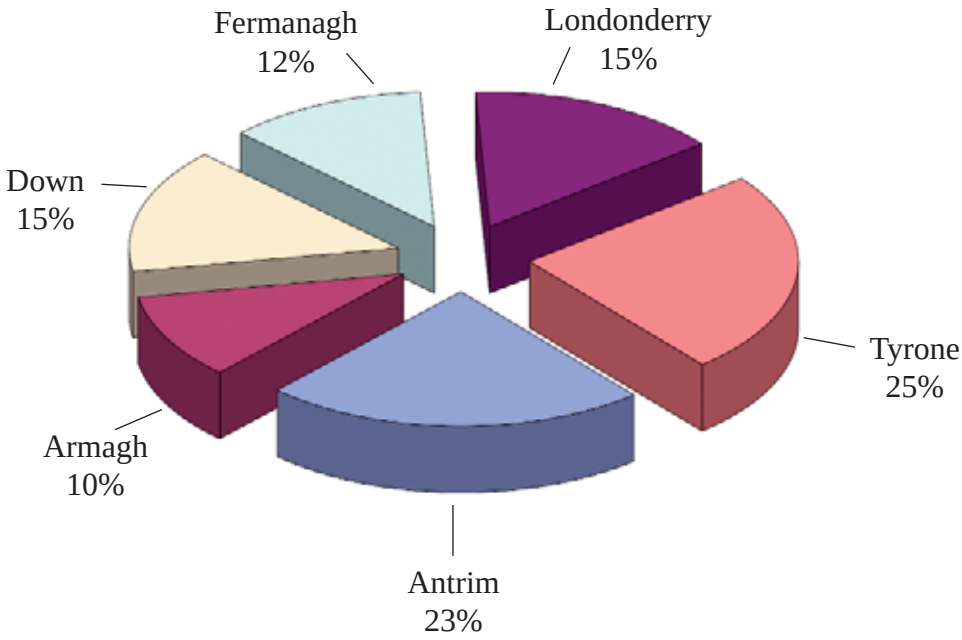

Figure 2 The proportional distribution of grassland and fodder crops grown in Northern Ireland in 2003.

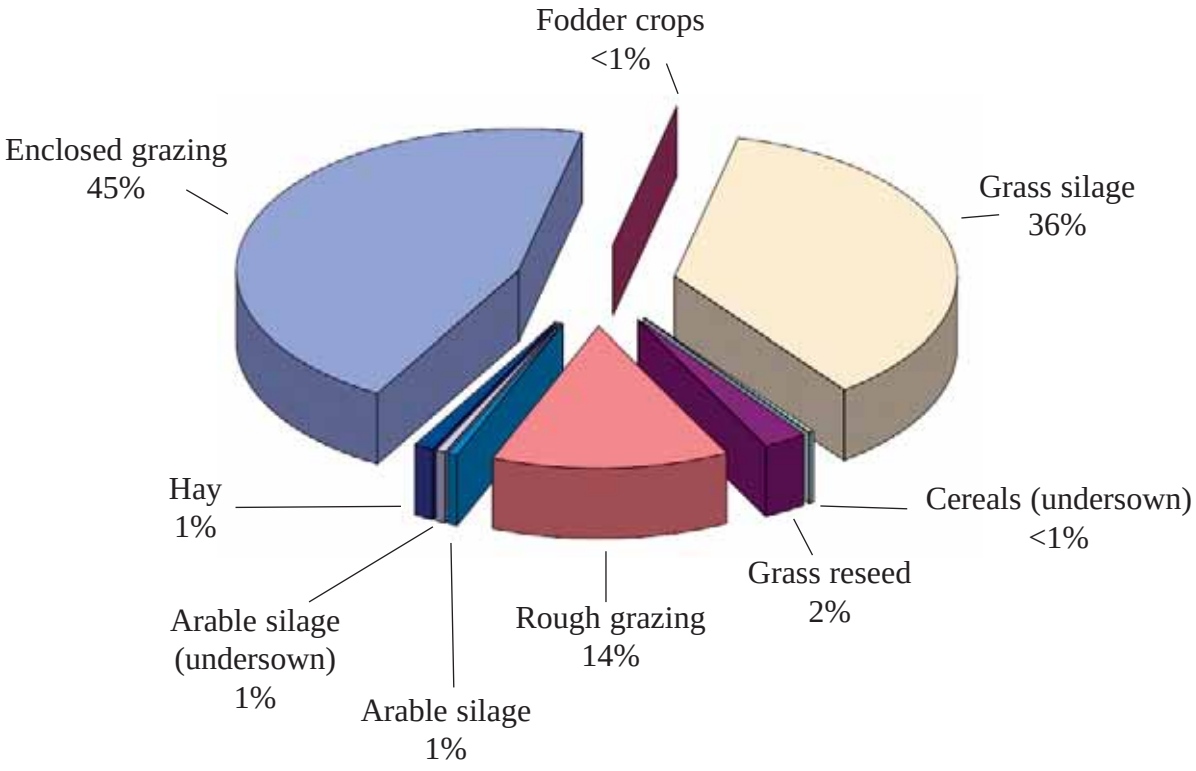

Table 1 **Number of farms in each size class with grassland and fodder crops in the Northern Ireland June 2003 census and the number of samples from each class.**

	Size group (hectares)													
	< 10		10 < 20		20 <30		30 < 50		50 < 100		100+		Total	
County	Holdings in strata	Holdings sampled	Holdings in strata	Holdings sampled	Holdings in strata	Holdings sampled	Holdings in strata	Holdings sampled	Holdings in strata	Holdings sampled	Holdings in strata	Holdings sampled	Holdings in strata	Holdings sampled
Antrim	873	2	829	4	673	4	941	15	1,029	18	440	20	4,785	63
Armagh	1,188	3	1,084	8	621	6	607	6	375	8	78	3	3,953	34
Down	1,410	2	1,223	6	763	7	890	11	731	17	216	7	5,233	50
Fermanagh	453	4	801	2	565	1	728	10	552	8	197	13	3,296	38
Londonderry	721	4	735	4	513	3	665	6	663	15	328	13	3,625	45
Tyrone	1,183	4	1,491	6	1,143	6	1,365	21	1,105	19	383	21	6,670	77
Northern Ireland	**5,828**	**19**	**6,163**	**30**	**4,278**	**27**	**5,196**	**69**	**4,455**	**85**	**1,642**	**77**	**27,562**	**307**

Table 2 **The total number and area (hectares) of crops sampled, and the proportion (%) of the total area of grassland and fodder crops surveyed in Northern Ireland, 2003.**

CROP	Number of crops surveyed	Survey area (ha)	Proportion of crops surveyed (%)
Established grassland crops			
Enclosed grazing	302	10,547	2.0
Grass silage 1st cut	283	5,443	2.0
Grass silage 2nd cut	193	3,186	2.1
Grass silage 3rd cut	14	171	2.3
Hay	81	216	1.8
Rough grazing	152	5,227	3.2
Sown crops			
Arable silage	25	128	1.5
Arable silage (undersown)	44	142	2.2
Cereals (undersown)	25	132	3.2
Grass reseed	111	631	2.3
Fodder crops	8	46	1.9
All crops	**1,238**	**25,868**	**2.2**

Table 3 **Estimated area (hectares) of grassland and fodder crops grown regionally in Northern Ireland 2003.**

CROP	County						Northern Ireland
	Antrim	Armagh	Down	Fermanagh	Londonderry	Tyrone	
Established grassland crops							
Enclosed grazing	103,744	53,676	102,070	67,374	78,900	131,970	537,735
Grass silage 1st cut	59,884	29,807	37,124	38,784	33,138	74,383	273,119
Grass silage 2nd cut	37,610	19,830	19,733	11,271	21,407	40,241	150,093
Grass silage 3rd cut	1,542	2,331	1,670	.	107	1,680	7,330
Hay	1,644	2,606	2,489	2,428	1,233	1,596	11,997
Rough grazing	61,056	5,346	9,021	20,467	38,261	28,179	162,330
Sown crops							
Arable silage	897	4,358	2,578	.	460	427	8,720
Arable silage (undersown)	2,341	.	2,229	177	1,195	570	6,512
Cereals (undersown)	694	.	1,317	123	986	967	4,086
Grass reseed	6,464	3,109	1,351	735	4,508	11,114	27,282
Fodder crops							
Fodder kale	.	335	.	.	.	.	335
Fodder maize	.	.	122	.	.	1,342	1,463
Fodder rape	.	.	157	.	.	.	157
Fodder turnip	.	.	258	.	206	.	464
All crops	**275,877**	**121,399**	**180,118**	**141,358**	**180,400**	**292,470**	**1,191,622**

Table 4 **Estimated area (spray hectares) of grassland and fodder crops treated regionally with each pesticide type in Northern Ireland 2003.**

Pesticide type	County						Northern Ireland
	Antrim	Armagh	Down	Fermanagh	Londonderry	Tyrone	
Fungicides	1,134	1,625	3,440	.	746	988	7,933
Herbicides	35,520	19,172	23,117	19,427	15,345	37,049	149,630
Insecticides	80	335	.	.	394	165	973
Growth regulators	509	967	.	.	394	.	1,870
Seed treatments	2,491	4,358	4,054	88	1,688	5,061	17,741
Total	**39,734**	**26,458**	**30,611**	**19,516**	**18,566**	**43,264**	**178,148**

Table 5 **Estimated quantity (kilogrammes) of pesticides applied to grassland and fodder crops regionally in Northern Ireland 2003.**

	County						
Pesticide type	**Antrim**	**Armagh**	**Down**	**Fermanagh**	**Londonderry**	**Tyrone**	**Northern Ireland**
Fungicides	528	673	896	.	176	143	2,417
Herbicides	26,801	15,358	17,401	3,274	10,773	24,369	97,976
Insecticides	58	322	.	.	8	6	393
Growth regulators	178	626	.	.	565	.	1,369
Seed treatments	23	61	81	1	27	265	458
Total	**27,588**	**17,040**	**18,378**	**3,275**	**11,550**	**24,783**	**102,613**

Table 6 **The total area (spray hectares) and the basic area (hectares), (in parentheses), of grassland and fodder crops treated, in Northern Ireland 2003, with each pesticide type.**

	Pesticide type											
	Fungicides		**Herbicides**		**Insecticides**		**Growth regulators**		**Seed treatments**		**All pesticides**	
CROP	**sp ha**	**(ha)**	**sp ha**	**(ha)**	**sp ha**	**(ha)**	**sp ha**	**(ha)**	**sp ha**	**(ha)**	**sp ha**	**(ha)**
Established grassland crops												
Enclosed grazing	.	.	65,821	(37,571)	.	.	.	.	.	.	65,821	(37,571)
Grass silage 1st cut	.	.	37,822	(34,486)	.	.	.	.	.	.	37,822	(34,486)
Grass silage 2nd cut	.	.	19,087	(14,155)	.	.	.	.	.	.	19,087	(14,155)
Grass silage 3rd cut	.	.	400	(295)	.	.	.	.	.	.	400	(295)
Hay	.	.	238	(238)	.	.	.	.	.	.	238	(238)
Rough grazing	.	.	2,591	(2,081)	.	.	.	.	.	.	2,591	(2,081)
Sown crops												
Arable silage	3,852	(2,210)	9,457	(7,640)	394	(394)	1,615	(1,293)	8,857	(8,131)	24,175	(8,535)
Arable silage (undersown)	2,431	(1,215)	3,197	(1,964)	.	.	254	(254)	3,304	(3,215)	9,186	(3,366)
Cereals (undersown)	1,315	(954)	1,542	(928)	165	(165)	.	.	1,399	(1,399)	4,421	(1,397)
Grass reseed	.	.	6,832	(5,841)	80	(80)	.	.	.	.	6,912	(5,761)
Fodder crops												
Fodder kale	335	(335)	.	.	335	(335)	.	.	.	.	670	(335)
Fodder maize	.	.	2,644	(1,463)	.	.	.	.	4025	(1,342)	6669	(1,463)
Fodder rape	.	.	.	.	.	.	.	.	157	(157)	157	(157)
Fodder turnip	.	.	.	.	.	.	.	.	.	.	.	.
All crops	**7,933**	**(4,715)**	**149,630**	**(106,662)**	**973**	**(973)**	**1,870**	**(1,547)**	**17741**	**(14,242)**	**178148**	**(109,839)**

Table 7 **Total quantities (kilogrammes) of each pesticide type applied to grassland and fodder crops in Northern Ireland 2003.**

CROP	Fungicides	Herbicides	Insecticides	Growth regulators	Seed treatments	Total
Established grassland crops						
Enclosed grazing	.	34,960	.	.	.	34,960
Grass silage 1st cut	.	26,176	.	.	.	26,176
Grass silage 2nd cut	.	13,829	.	.	.	13,829
Grass silage 3rd cut	.	379	.	.	.	379
Hay	.	228	.	.	.	228
Rough grazing	.	1,986	.	.	.	1,986
Sown crops						
Arable silage	930	7,294	8	1,280	164	9,675
Arable silage (undersown)	749	1,540	.	89	27	2,405
Cereals (undersown)	283	1,308	6	.	9	1,605
Grass reseed	.	7,953	58	.	.	8,011
Fodder crops						
Fodder kale	456	.	322	.	.	777
Fodder maize	.	2,323	.	.	226	2581
Fodder rape	.	.	.	.	1	1
Fodder turnip	.	.	.	.	.	.
All crops	**2,417**	**97,976**	**393**	**1,369**	**458**	**102,613**

Table 8 **The proportional area (%) of each crop treated with pesticides and the number of spray applications (in parentheses) in Northern Ireland, 2002.**

	Fungicides		Herbicides		Insecticides		Growth regulators		Seed treatments	All All pesticides	
	%	sp apps	%	sp apps	%	sp apps	%	sp apps	%	%	sp apps
Established grassland crops											
Enclosed grazing	.	.	7.0	(1.2)	.	.	.	.	.	7.0	(1.2)
Grass silage 1st cut	.	.	12.6	(1.0)	.	.	.	.	.	12.6	(1.0)
Grass silage 2nd cut	.	.	9.4	(1.1)	.	.	.	.	.	9.4	(1.1)
Grass silage 3rd cut	.	.	4.0	(1.4)	.	.	.	.	.	4.0	(1.4)
Hay	.	.	2.0	(1.0)	.	.	.	.	.	2.0	(1.0)
Rough grazing	.	.	1.3	(1.0)	.	.	.	.	.	1.3	(1.0)
Sown crops											
Arable silage	25.4	(1.8)	87.6	(1.3)	4.5	(1.0)	14.8	(1.2)	93.2	97.9	(2.2)
Arable silage (undersown)	18.7	(2.0)	30.2	(1.5)	.	.	3.9	(1.0)	49.4	51.7	(2.8)
Cereals (undersown)	23.3	(1.6)	22.7	(1.2)	4.0	(1.0)	.	.	34.2	34.2	(2.1)
Grass reseed	.	.	21.4	(1.0)	0.3	(1.0)	.	.	.	21.1	(1.0)
Fodder crops											
Fodder kale	100.0	(1.0)	.	.	100.0	(1.0)	.	.	.	100.0	(2.0)
Fodder maize	.	.	100.0	(1.6)	.	.	.	.	91.7	100.0	(1.6)
Fodder rape	.	.	.	.	.	.	.	.	100.0	100.0	.
Fodder turnip	.	.	.	.	.	.	.	.	.	.	.
All crops	**0.4**	**(1.7)**	**9.0**	**(1.1)**	**0.1**	**(1.0)**	**0.1**	**(1.2)**	**1.2**	**9.2**	**(1.2)**

Table 9 Estimated area (spray hectares) of grassland and fodder crops treated with pesticide formulations in Northern Ireland in 2003

Pesticide type & formulation	Enclosed grazing	Silage 1st cut	Silage 2nd cut	Silage 3rd cut	Hay	Rough grazing	Arable silage	Arable silage (undersown)	Cereals (undersown)	Grass reseed	Fodder kale	Fodder maize	Fodder rape	All crops
Fungicides														
Azoxystrobin	.	.	.	.	.	.	652	.	.	.	.	.	.	652
Carbendazim/flusilazole	.	.	.	.	.	.	.	54	197	.	.	.	.	250
Cyproconazole/trifloxystrobin	.	.	.	.	.	.	697	907	.	.	.	.	.	1,604
Epoxiconazole	.	.	.	.	.	.	652	.	.	.	.	.	.	652
Epoxiconazole/ kresoxim-methyl	.	.	.	.	.	.	102	.	.	.	.	.	.	102
Fenpropimorph	.	.	.	.	.	.	.	.	165	.	.	.	.	165
Fenpropimorph/quinoxyfen	.	.	.	.	.	.	.	54	197	.	.	.	.	250
Mancozeb	.	.	.	.	.	.	.	.	.	.	335	.	.	335
Propiconazole	.	.	.	.	.	.	.	.	143	.	.	.	.	143
Tebuconazole	.	.	.	.	.	.	1,057	907	450	.	.	.	.	2,414
Tebuconazole/triadimenol	.	.	.	.	.	.	183	.	165	.	.	.	.	348
Unknown fungicide	.	.	.	.	.	.	509	509	.	.	.	.	.	1,018
All fungicides	**.**	**.**	**.**	**.**	**.**	**.**	**3,852**	**2,431**	**1,316**	**.**	**335**	**.**	**.**	**7,933**
Herbicides														
Amidosulfuron	1,630	386	45	.	.	.	.	.	.	.	.	.	.	2,061
Atrazine	.	.	.	.	.	.	.	.	.	.	.	1,342	.	1,342
Benazolin/2,4-DB/MCPA	.	.	.	.	.	.	.	205	789	172	.	.	.	1,166
Bromoxynil	.	.	.	.	.	.	.	.	.	.	.	122	.	122
Clopyralid/fluroxypyr/ triclopyr	2,945	66	191	.	.	.	.	.	.	.	.	.	.	3,202
Clopyralid/triclopyr	2,283	342	.	.	.	.	.	.	.	.	.	.	.	2,625
2,4-D	699	.	.	.	.	.	.	.	.	.	.	.	.	699
2,4-DB/linuron/MCPA	.	.	47	.	.	.	46	116	153	.	.	.	.	362
Dicamba/MCPA/mecoprop	3,683	132	958	.	.	.	.	.	.	.	.	.	.	4,772
Dicamba/MCPA/mecoprop-P	2,155	2,297	2,343	105	223	.	.	.	209	94	.	.	.	7,426
Dicamba/mecoprop	1,518	1,541	492	190	.	22	.	.	.	.	.	.	.	3,763
Dicamba/mecoprop-P	501	2,775	.	.	15	.	.	.	.	.	.	.	.	3,291
Fluroxypyr/triclopyr	10,820	21,281	10,152	105	.	490	.	.	.	228	.	.	.	43,077
Glyphosate	21,304	72	.	.	.	.	759	71	12	5,072	.	122	.	27,411
Isoproturon	.	22	.	.	.	.	.	.	.	.	.	.	.	22
MCPA	9,610	5,384	2,463	.	.	1,299	533	224	.	476	.	.	.	19,988
MCPA/MCPB	.	.	6	.	.	.	.	.	.	.	.	.	.	6

Table 9 (cont.) **Estimated area (spray hectares) of grassland and fodder crops treated with pesticide formulations in Northern Ireland in 2003**

Pesticide type & formulation	Enclosed grazing	Silage 1st cut	Silage 2nd cut	Silage 3rd cut	Hay	Rough grazing	Arable silage	Arable silage (undersown)	Cereals (undersown)	Grass reseed	Fodder kale	Fodder maize	Fodder rape	All crops
Herbicides (cont.)														
MCPB	.	.	.	.	.	.	999	89	.	.	.	.	.	1,088
Mecoprop	3,472	.	1,177	.	.	.	645	.	.	38	.	.	.	5,331
Mecoprop-P	3,438	3,227	863	.	.	.	412	974	165	.	.	.	.	9,079
Metsulfuron-methyl	.	.	.	.	.	.	2,148	1,010	50	.	.	.	.	3,207
Metsulfuron-methyl/ tribenuron-methyl	.	.	.	.	.	.	394	.	165	.	.	.	.	558
Paraquat	16	.	.	.	.	.	.	.	.	.	.	.	.	16
Propyzamide	.	.	.	.	.	.	102	.	.	.	.	.	.	102
Thifensulfuron-methyl/ tribenuron-methyl	.	.	.	.	.	.	169	.	.	.	.	.	.	169
Unknown herbicide	1,746	298	351	.	.	780	3,251	509	.	752	.	1,059	.	8,746
All herbicides	**65,821**	**37,822**	**19,087**	**400**	**238**	**2,591**	**9,457**	**3,197**	**1,542**	**6,832**	**.**	**2,644**	**.**	**149,630**
Insecticides														
Chlorpyrifos	.	.	.	.	.	.	.	.	.	80	335	.	.	415
Cypermethrin	.	.	.	.	.	.	394	.	165	.	.	.	.	558
All insecticides	**.**	**.**	**.**	**.**	**.**	**.**	**394**	**.**	**165**	**80**	**335**	**.**	**.**	**974**
Growth regulators														
Chlormequat	.	.	.	.	.	.	1,615	255	.	.	.	.	.	1,870
All growth regulators	**.**	**.**	**.**	**.**	**.**	**.**	**1,615**	**255**	**.**	**.**	**.**	**.**	**.**	**1,870**
Seed treatments														
Fludioxonil	.	.	.	.	.	.	7,763	3,215	1,399	.	.	.	.	12,376
Fludioxonil/metalaxyl-m	.	.	.	.	.	.	.	.	.	.	.	1,342	.	1,342
Thiram	.	.	.	.	.	.	992	89	.	.	.	1,342	157	2,580
Methiocarb	.	.	.	.	.	.	.	.	.	.	.	1,342	.	1,342
Unknown seed treatment	.	.	.	.	.	.	102	.	.	.	.	.	.	102
All seed treatments	**.**	**.**	**.**	**.**	**.**	**.**	**8,857**	**3,304**	**1,399**	**.**	**.**	**4,025**	**157**	**17,741**
All pesticides	**65,821**	**37,822**	**19,087**	**400**	**238**	**2,591**	**24,175**	**9,186**	**4,421**	**6,912**	**670**	**6,669**	**157**	**178,148**

Table 10 Estimated quantities (kilogrammes) of grassland and fodder crops treated with pesticide formulations in Northern Ireland in 2003

Pesticide type & formulation	Enclosed grazing	Silage 1st cut	Silage 2nd cut	Silage 3rd cut	Hay	Rough grazing	Arable silage	Arable silage (undersown)	Cereals (undersown)	Grass reseed	Fodder kale	Fodder maize	Fodder rape	All crops
Fungicides														
Azoxystrobin	.	.	.	.	.	.	131	.	.	.	.	.	.	131
Carbendazim/flusilazole	.	.	.	.	.	.	.	16	59	.	.	.	.	75
Cyproconazole/trifloxystrobin	.	.	.	.	.	.	161	243	.	.	.	.	.	403
Epoxiconazole	.	.	.	.	.	.	49	.	.	.	.	.	.	49
Epoxiconazole/ kresoxim-methyl	.	.	.	.	.	.	26	.	.	.	.	.	.	26
Fenpropimorph	.	.	.	.	.	.	.	.	35	.	.	.	.	35
Fenpropimorph/quinoxyfen	.	.	.	.	.	.	.	9	31	.	.	.	.	40
Mancozeb	.	.	.	.	.	.	.	.	.	.	456	.	.	456
Propiconazole	.	.	.	.	.	.	.	.	36	.	.	.	.	36
Tebuconazole	.	.	.	.	.	.	240	227	112	.	.	.	.	579
Tebuconazole/triadimenol	.	.	.	.	.	.	69	.	9	.	.	.	.	78
Unknown fungicide	.	.	.	.	.	.	255	255	.	.	.	.	.	509
All fungicides	**.**	**.**	**.**	**.**	**.**	**.**	**930**	**749**	**283**	**.**	**456**	**.**	**.**	**2,417**
Herbicides														
Amidosulfuron	4	1	<1	.	.	.	.	.	.	.	.	.	.	5
Atrazine	.	.	.	.	.	.	.	.	.	.	.	1,271	.	1,271
Benazolin/2,4-DB/MCPA	.	.	.	.	.	.	.	162	874	147	.	.	.	1,183
Bromoxynil	.	.	.	.	.	.	.	.	.	.	.	73	.	73
Clopyralid/fluroxypyr/ triclopyr	769	30	86	.	.	.	.	.	.	.	.	.	.	884
Clopyralid/triclopyr	2,045	349	.	.	.	.	.	.	.	.	.	.	.	2,393
2,4-D	304	.	.	.	.	.	.	.	.	.	.	.	.	304
2,4-DB/linuron/MCPA	.	.	10	.	.	.	13	32	43	.	.	.	.	98
Dicamba/MCPA/mecoprop	3,287	119	1,798	.	.	.	.	.	.	.	.	.	.	5,204
Dicamba/MCPA/mecoprop-P	2,708	2,752	3,492	134	226	.	.	.	240	96	.	.	.	9,648
Dicamba/mecoprop	1,457	1,332	318	182	.	21	.	.	.	.	.	.	.	3,310
Dicamba/mecoprop-P	368	1,987	.	.	2	.	.	.	.	.	.	.	.	2,358
Fluroxypyr/triclopyr	5,646	11,697	4,933	63	.	294	.	.	.	46	.	.	.	22,680
Glyphosate	2,488	90	.	.	.	.	536	39	62	5,393	.	132	.	8,739
Isoproturon	.	55	.	.	.	.	.	.	.	.	.	.	.	55
MCPA	7,881	5,098	862	.	.	891	85	43	.	469	.	.	.	15,328
MCPA/MCPB	.	.	9	.	.	.	.	.	.	.	.	.	.	9

Table 10 (cont.) **Estimated quantities (kilogrammes) of grassland and fodder crops treated with pesticide formulations in Northern Ireland in 2003**

Pesticide type & formulation	Enclosed grazing	Silage 1st cut	Silage 2nd cut	Silage 3rd cut	Hay	Rough grazing	Arable silage	Arable silage (undersown)	Cereals (undersown)	Grass reseed	Fodder kale	Fodder maize	Fodder rape	All crops
Herbicides (cont.)														
MCPB	.	.	.	.	.	.	2,581	160	.	.	.	.	.	2,742
Mecoprop	3,835	.	659	.	.	.	361	.	.	52	.	.	.	4,907
Mecoprop-P	2,640	2,368	1,312	.	.	.	348	844	71	.	.	.	.	7,583
Metsulfuron-methyl	.	.	.	.	.	.	9	5	<1	.	.	.	.	14
Metsulfuron-methyl/ tribenuron-methyl	.	.	.	.	.	.	4	.	18	.	.	.	.	23
Paraquat	16	.	.	.	.	.	.	.	.	.	.	.	.	16
Propyzamide	.	.	.	.	.	.	102	.	.	.	.	.	.	102
Thifensulfuron-methyl/ tribenuron-methyl	.	.	.	.	.	.	4	.	.	.	.	.	.	4
Unknown herbicide	1,512	298	351	.	.	780	3,251	255	.	1,751	.	847	.	9,044
All herbicides	**34,960**	**26,176**	**13,829**	**379**	**228**	**1,986**	**7,294**	**1,540**	**1,308**	**7,953**	**.**	**2,323**	**.**	**97,976**
Insecticides														
Chlorpyrifos	.	.	.	.	.	.	.	.	.	58	322	.	.	379
Cypermethrin	.	.	.	.	.	.	8	.	6	.	.	.	.	14
All insecticides	**.**	**.**	**.**	**.**	**.**	**.**	**8**	**.**	**6**	**58**	**322**	**.**	**.**	**393**
Growth regulators														
Chlormequat	.	.	.	.	.	.	1,280	89	.	.	.	.	.	1,369
All growth regulators	**.**	**.**	**.**	**.**	**.**	**.**	**1,280**	**89**	**.**	**.**	**.**	**.**	**.**	**1,369**
Seed treatments														
Fludioxonil	.	.	.	.	.	.	50	19	9	.	.	.	.	77
Fludioxonil/metalaxyl-m	.	.	.	.	.	.	.	.	.	.	.	1	.	1
Thiram	.	.	.	.	.	.	97	8	.	.	.	31	1	137
Methiocarb	.	.	.	.	.	.	.	.	.	.	.	226	.	226
Unknown seed treatment	.	.	.	.	.	.	18	.	.	.	.	.	.	18
All seed treatments	**.**	**.**	**.**	**.**	**.**	**.**	**164**	**27**	**9**	**.**	**.**	**258**	**1**	**458**
All pesticides	**34,960**	**26,176**	**13,829**	**379**	**228**	**1,986**	**9,675**	**2,405**	**1,605**	**8,011**	**777**	**2,581**	**1**	**102,613**

Table 11 **The thirty active ingredients used most extensively on grassland and fodder crops in Northern Ireland in 2003, ranked by area treated (spray hectares).**

	Active ingredient	Treated area (sp ha)
1	Triclopyr	48904
2	Fluroxypyr	46279
3	MCPA	33720
4	Glyphosate	27411
5	Mecoprop-P	19796
6	Dicamba	19252
7	Mecoprop	13866
8	Clopyralid	5827
9	Metsulfuron-methyl	3765
10	Tebuconazole	2762
11	Amidosulfuron	2061
12	Chlormequat	1870
13	Trifloxystrobin	1604
14	Cyproconazole	1604
15	2,4-DB	1528
16	Atrazine	1342
17	Benazolin	1166
18	MCPB	1094
19	Epoxiconazole	754
20	Tribenuron-methyl	727
21	2,4-D	699
22	Azoxystrobin	652
23	Cypermethrin	558
24	Chlorpyrifos	415
25	Fenpropimorph	415
26	Linuron	362
27	Triadimenol	347
28	Mancozeb	335
29	Quinoxyfen	250
30	Carbendazim	250

Table 12 **The thirty active ingredients used most extensively on grassland and fodder crops in Northern Ireland in 2003, ranked by weight applied (kilogrammes).**

	Active ingredient	Weight (kg)
1	MCPA	21036
2	Mecoprop-P	13933
3	Triclopyr	13648
4	Fluroxypyr	11635
5	Mecoprop	10973
6	Glyphosate	8739
7	MCPB	2750
8	Dicamba	2572
9	Chlormequat	1369
10	Atrazine	1271
11	2,4-DB	991
12	Clopyralid	675
13	Tebuconazole	631
14	Mancozeb	456
15	Chlorpyrifos	379
16	2,4-D	304
17	Trifloxystrobin	283
18	Azoxystrobin	131
19	Cyproconazole	121
20	Benazolin	104
21	Propyzamide	102
22	Bromoxynil	73
23	Fenpropimorph	67
24	Epoxiconazole	61
25	Isoproturon	55
26	Flusilazole	50
27	Propiconazole	36
28	Triadimenol	27
29	Carbendazim	25
30	Metsulfuron-methyl	21

Table 13 **Enclosed grazing: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	Ragwort	Docks	Ground preparation	Chickweed	Rushes	Docks/ chickweed	Rushes/ thistles	Briars	Thistles	Buttercup	Ragwort/ thistles	Nettles	Docks/ nettles	Thistles/ buttercup	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides																		
Amidosulfuron	.	.	1,630	.	.	.	.	.	.	.	.	.	.	.	.	1,630	1,630	4
Clopyralid/fluroxypyr/ triclopyr	327	.	2,529	.	.	.	.	.	.	.	.	.	.	88	.	2,945	2,945	769
Clopyralid/triclopyr	2,145	.	.	.	.	33	.	.	22	69	.	.	15	.	.	2,283	2,283	2,045
2,4-D	.	258	.	.	.	.	.	.	.	.	.	441	.	.	.	699	699	304
Dicamba/MCPA/mecoprop	.	.	3,683	.	.	.	.	.	.	.	.	.	.	.	.	3,683	3,683	3,287
Dicamba/MCPA/ mecoprop-P	.	.	152	.	1,740	.	263	.	.	.	.	.	.	.	.	2,155	2,155	2,708
Dicamba/mecoprop	.	.	1,518	.	.	.	.	.	.	.	.	.	.	.	.	1,518	1,518	1,457
Dicamba/mecoprop-P	.	.	501	.	.	.	.	.	.	.	.	.	.	.	.	501	501	368
Fluroxypyr/triclopyr	.	.	9,988	.	.	.	231	.	.	.	.	.	602	.	.	10,820	10,820	5,646
Glyphosate	405	.	3,084	733	.	17,082	.	.	.	.	.	.	.	.	.	21,304	7,901	2,488
MCPA	2,404	.	1,168	.	235	4,498	.	490	.	129	471	.	.	.	215	9,610	9,574	7,881
Mecoprop	2,295	.	1,177	.	.	.	.	.	.	.	.	.	.	.	.	3,472	3,472	3,835
Mecoprop-P	327	.	1,073	.	.	.	.	221	.	75	.	1,740	.	.	.	3,438	3,438	2,640
Paraquat	.	.	.	.	.	.	.	.	.	16	.	.	.	.	.	16	16	16
Unknown herbicide	.	.	235	.	.	140	.	.	.	1,371	.	.	.	.	.	1,746	1,746	1,512
All herbicides	**7,903**	**258**	**26,738**	**733**	**1,976**	**21,753**	**494**	**711**	**22**	**1,661**	**471**	**2,181**	**616**	**88**	**215**	**65,821**	**37,571**	**34,960**

Table 14 **Grass silage 1st cut: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	Ragwort	Docks	Ground preparation	Chickweed	Thistles/ nettles	Rushes	Docks/ chickweed	Docks/ thistles	Thistles	Nettles	Docks/ nettles	Dandelion	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides																
Amidosulfuron	.	.	386	.	.	.	.	.	.	.	.	.	.	386	386	1
Clopyralid/fluroxypyr/ triclopyr	.	.	.	.	.	.	.	.	.	.	.	66	.	66	66	30
Clopyralid/triclopyr	334	.	.	.	.	.	.	.	.	.	7	.	.	342	342	349
Dicamba/MCPA/mecoprop	.	.	132	.	.	.	.	.	.	.	.	.	.	132	132	119
Dicamba/MCPA/ mecoprop-P	.	.	2,038	.	.	.	.	105	.	.	154	.	.	2,297	2,297	2,752
Dicamba/mecoprop	.	.	76	.	.	.	.	1,466	.	.	.	.	.	1,541	1,541	1,332
Dicamba/mecoprop-P	.	.	2,553	221	.	.	.	.	.	.	.	.	.	2,775	2,775	1,987
Fluroxypyr/triclopyr	.	.	20,911	.	370	.	.	.	.	.	.	.	.	21,281	21,281	11,697
Glyphosate	.	.	.	72	.	.	.	.	.	.	.	.	.	72	72	90
Isoproturon	.	.	.	.	.	.	.	.	.	.	22	.	.	22	22	55
MCPA	589	.	1,068	.	.	578	1,894	.	356	836	.	.	62	5,384	5,295	5,098
Mecoprop-P	2,104	102	623	.	398	.	.	.	.	.	.	.	.	3,227	3,227	2,368
Unknown herbicide	.	.	.	.	.	.	298	.	.	.	.	.	.	298	298	298
All herbicides	**3,028**	**102**	**27,786**	**293**	**769**	**578**	**2,192**	**1,571**	**356**	**836**	**184**	**66**	**62**	**37,822**	**34,486**	**26,176**

Table 15 **Grass silage 2nd cut: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	Docks	Chickweed	Rushes	Thistles	Buttercup	Rushes/ docks	Ragwort/ thistles	Nettles	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides											
Amidosulfuron	45	.	.	.	.	.	.	.	45	45	0.1
Clopyralid/fluroxypyr/triclopyr	191	.	.	.	.	.	.	.	191	191	86
2,4-DB/linuron/MCPA	.	47	.	.	.	.	.	.	47	47	10
Dicamba/MCPA/mecoprop	958	.	.	.	.	.	.	.	958	958	1,798
Dicamba/MCPA/mecoprop-P	1,784	522	.	.	.	.	.	37	2,343	2,343	3,492
Dicamba/mecoprop	492	.	.	.	.	.	.	.	492	492	318
Fluroxypyr/triclopyr	9,255	897	.	.	.	.	.	.	10,152	10,152	4,933
MCPA	749	.	184	.	712	817	.	.	2,463	2,463	862
MCPA/MCPB	.	.	.	6	.	.	.	.	6	6	9
Mecoprop	1,177	.	.	.	.	.	.	.	1,177	1,177	659
Mecoprop-P	341	.	.	.	.	.	522	.	863	863	1,312
Unknown herbicide	148	203	.	.	.	.	.	.	351	351	351
All herbicides	**15,139**	**1,669**	**184**	**6**	**712**	**817**	**522**	**37**	**19,087**	**14,155**	**13,829**

Table 16 **Grass silage 3rd cut: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	Docks	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides				
Dicamba/MCPA/mecoprop-P	105	105	105	134
Dicamba/mecoprop	190	190	190	182
Fluroxypyr/triclopyr	105	105	105	63
All herbicides	**400**	**400**	**295**	**379**

Table 17 **Hay: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	Docks	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides				
Dicamba/MCPA/mecoprop-P	223	223	223	226
Dicamba/mecoprop-P	15	15	15	2
All herbicides	**238**	**238**	**238**	**228**

Table 18 **Rough grazing: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	Docks	Rushes	Rushes/ thistles	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides						
Dicamba/mecoprop	.	.	22	22	22	21
Fluroxypyr/triclopyr	490	.	.	490	490	294
MCPA	.	1,299	.	1,299	1,299	891
Unknown herbicide	511	269	.	780	780	780
All herbicides	**1,001**	**1,568**	**22**	**2,591**	**2,081**	**1,986**

Table 19 **Arable silage: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	Aphids	General disease control	Growth regulation	Stubble treatment	Ground preparation	All reasons	Basic area (ha) of treatment	Weight (kg)
Fungicides									
Azoxystrobin	.	.	652	.	.	.	652	652	131
Cyproconazole/trifloxystrobin	.	.	697	.	.	.	697	697	161
Epoxiconazole	.	.	652	.	.	.	652	652	49
Epoxiconazole/kresoxim-methyl	.	.	102	.	.	.	102	102	26
Tebuconazole	.	.	1,057	.	.	.	1,057	1,057	240
Tebuconazole/triadimenol	.	.	183	.	.	.	183	183	69
Unknown fungicide	.	.	509	.	.	.	509	255	255
All fungicides	**.**	**.**	**3,852**	**.**	**.**	**.**	**3,852**	**2,210**	**930**
Herbicides									
2,4-DB/linuron/MCPA	46	.	.	.	.	.	46	46	13
Glyphosate	394	.	.	.	183	183	759	576	536
MCPA	533	.	.	.	.	.	533	533	85
MCPB	999	.	.	.	.	.	999	999	2,581
Mecoprop	645	.	.	.	.	.	645	645	361
Mecoprop-P	412	.	.	.	.	.	412	412	348
Metsulfuron-methyl	2,148	.	.	.	.	.	2,148	2,148	9
Metsulfuron-methyl/ tribenuron-methyl	394	.	.	.	.	.	394	394	4
Propyzamide	102	.	.	.	.	.	102	102	102
Thifensulfuron-methyl/ tribenuron-methyl	169	.	.	.	.	.	169	169	4
Unknown herbicide	3,205	.	.	.	.	46	3,251	3,251	3,251
All herbicides	**9,046**	**.**	**.**	**.**	**183**	**228**	**9,457**	**7,640**	**7,294**

Table 19 (cont.) **Arable silage: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	Aphids	General disease control	Growth regulation	Stubble treatment	Ground preparation	All reasons	Basic area (ha) of treatment	Weight (kg)
Insecticides									
Cypermethrin	.	394	.	.	.	.	394	394	8
All insecticides	**.**	**394**	**.**	**.**	**.**	**.**	**394**	**394**	**8**
Growth regulators									
Chlormequat	.	.	.	1,615	.	.	1,615	1,293	1,280
All growth regulators	**.**	**.**	**.**	**1,615**	**.**	**.**	**1,615**	**1,293**	**1,280**

Table 20 **Arable silage (undersown): pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	General disease control	Growth regulation	Ground preparation	Chickweed	Redshank	All reasons	Basic area (ha) of treatment	Weight (kg)
Fungicides									
Carbendazim/flusilazole	.	54	.	.	.	.	54	54	16
Cyproconazole/trifloxystrobin	.	907	.	.	.	.	907	907	243
Fenpropimorph/quinoxyfen	.	54	.	.	.	.	54	54	9
Tebuconazole	.	907	.	.	.	.	907	907	227
Unknown fungicide	.	509	.	.	.	.	509	255	255
All fungicides	**.**	**2,431**	**.**	**.**	**.**	**.**	**2,431**	**1215**	**749**
Herbicides									
Benazolin/2,4-DB/MCPA	205	.	.	.	.	.	205	205	162
2,4-DB/linuron/MCPA	116	.	.	.	.	.	116	116	32
Glyphosate	.	.	.	71	.	.	71	71	39
MCPA	152	.	.	.	.	71	224	224	43
MCPB	.	.	.	89	.	.	89	89	160
Mecoprop-P	907	.	.	.	66	.	974	974	844
Metsulfuron-methyl	1,010	.	.	.	.	.	1,010	1010	5
Unknown herbicide	509	.	.	.	.	.	509	255	255
All herbicides	**2,899**	**.**	**.**	**160**	**66**	**71**	**3,197**	**1964**	**1,540**
Growth Regulators									
Chlormequat	.	.	255	.	.	.	255	255	89
All growth regulators	**.**	**.**	**255**	**.**	**.**	**.**	**255**	**255**	**89**

Table 21 **Cereals (undersown): pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	Aphids	General disease control	All reasons	Basic area (ha) of treatment	Weight (kg)
Fungicides						
Carbendazim/flusilazole	.	.	197	197	197	59
Fenpropimorph	.	.	165	165	165	35
Fenpropimorph/quinoxyfen	.	.	197	197	197	31
Propiconazole	.	.	143	143	143	36
Tebuconazole	.	.	450	450	450	112
Tebuconazole/triadimenol	.	.	165	165	165	9
All fungicides	**.**	**.**	**1,316**	**1,316**	**954**	**283**
Herbicides						
Benazolin/2,4-DB/MCPA	789	.	.	789	789	874
2,4-DB/linuron/MCPA	153	.	.	153	153	43
Dicamba/MCPA/mecoprop-P	209	.	.	209	209	240
Glyphosate	12	.	.	12	12	62
Mecoprop-P	165	.	.	165	165	71
Metsulfuron-methyl	50	.	.	50	50	0.1
Metsulfuron-methyl/ tribenuron-methyl	165	.	.	165	165	18
All herbicides	**1,542**	**.**	**.**	**1,542**	**928**	**1,308**
Insecticides						
Cypermethrin	.	165	.	165	165	6
All insecticides	**.**	**165**	**.**	**165**	**165**	**6**

Table 22 **Grass reseed: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	Leatherjackets	Docks	Ground preparation	Chickweed	Redshank	Redshank/ chickweed	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides										
Benazolin/2,4-DB/MCPA	.	.	.	61	.	111	.	172	172	147
Dicamba/MCPA/mecoprop-P	.	.	94	.	.	.	.	94	94	96
Fluroxypyr/triclopyr	.	.	.	.	228	.	.	228	228	46
Glyphosate	177	.	30	4,619	247	.	.	5,072	4,722	5,393
MCPA	.	.	.	.	221	.	255	476	476	469
Mecoprop	.	.	.	.	38	.	.	38	38	52
Unknown herbicide	.	.	.	752	.	.	.	752	752	1,751
All herbicides	**177**	**.**	**124**	**5,433**	**733**	**111**	**255**	**6,832**	**5,841**	**7,953**
Insecticides										
Chlorpyrifos	.	80	.	.	.	.	.	80	80	58
All insecticides	**.**	**80**	**.**	**.**	**.**	**.**	**.**	**80**	**80**	**58**

Table 23 **Fodder kale: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	Caterpillars	Blight	All reasons	Basic area (ha) of treatment	Weight (kg)
Fungicides					
Mancozeb	.	335	335	335	456
All fungicides	**.**	**335**	**335**	**335**	**456**
Insecticides					
Chlorpyrifos	335	.	335	335	322
All insecticides	**335**	**.**	**335**	**335**	**322**

Table 24 **Fodder maize: pesticide-treated area (spray-hectares), weight of pesticide applied (kilogrammes) and reason for use.**

Pesticide type & formulation	General weed control	Annual dicotyledons	Ground preparation	All reasons	Basic area (ha) of treatment	Weight (kg)
Herbicides						
Atrazine	1,342	.	.	1,342	1,342	1,271
Bromoxynil	.	122	.	122	122	73
Glyphosate	.	.	122	122	122	132
Unknown herbicide	1,059	.	.	1,059	1,059	847
All herbicides	**2,401**	**122**	**122**	**2,644**	**1,463**	**2,323**

Table 25 **Comparison of the area (hectares) of grassland and fodder crops grown in Northern Ireland, 1989-2003.**

Crop	Survey year 1989 Area grown (ha)	1993 Area grown (ha)	1997 Area grown (ha)	2003 Area grown (ha)
Established grassland crops				
Enclosed grazing	481,059	476,209	512,819	537,735
Grass silage	243,149	252,502	422,650	430,542
Hay	66,001	33,017	32,303	11,997
Rough grazing	212,930	173,239	165,005	162,330
All established grassland crops	**1,003,139**	**934,967**	**1,132,777**	**1,142,603**
Sown crops				
Arable silage	3,762	.	766	8,720
Arable silage (undersown)	.	2,073	3,308	6,512
Cereals (undersown)	6,213	5,907	4,284	4,086
Grass reseed	35,434	5,380	11,472	27,282
All sown crops	**45,409**	**13,360**	**19,830**	**46,600**
Fodder crops				
Fodder beet	.	.	70	.
Fodder kale	.	72	45	335
Fodder kale (undersown)	.	.	58	.
Fodder maize	.	.	10	1,463
Fodder rape	.	.	99	157
Fodder turnip	371	.	250	464
All fodder crops	**371**	**72**	**532**	**2,419**
All crops	**1,048,919**	**948,400**	**1,153,138**	**1,191,622**

Table 26 **Comparison of pesticide usage on grassland & fodder crops in Northern Ireland 1989-2003, area treated (spray hectares) and weight applied (tonnes).**

	Survey year							
	1989		1993		1997		2003	
Crop	Area (sp ha)	Weight (t)	Area (sp ha)	Weight (t)	Area (sp ha)	Weight (t)	Area (sp ha)	Weight (t)
Established grassland crops								
Enclosed grazing	25,252	43.11	35,051	55.38	48,536	80.41	65,821	34.96
Grass silage	26,921	42.17	41,091	64.57	50,209	74.49	57,309	40.38
Hay	2,673	2.82	490	0.57	843	1.34	238	0.23
Rough grazing	2,736	3.48	1,866	3.75	1,710	2.75	2,591	1.99
All established grassland crops	**57,582**	**91.58**	**78,498**	**124.27**	**101,298**	**158.99**	**125,959**	**77.56**
Sown crops								
Arable silage	8,138	3.66	.	.	2,299	1.59	24,175	9.68
Arable silage (undersown)	.	.	3,632	0.38	2,830	0.15	9,186	2.40
Cereals (undersown)	11,190	11.62	5,212	6.70	4,804	4.73	4,421	1.60
Grass reseed	32,344	15.33	4,090	3.51	7,377	2.91	6,912	8.01
All sown crops	**51,672**	**30.61**	**12,934**	**10.59**	**17,310**	**9.39**	**44,694**	**21.69**
Fodder crops								
Fodder beet	.	.	.	.	227	0.09	.	.
Fodder kale	.	.	98	0.02	105	0.21	670	0.78
Fodder kale (undersown)	.	.	.	.	203	0.25	.	.
Fodder maize	.	.	.	.	20	0.03	6,669	2.58
Fodder rape	.	.	.	.	164	0.25	157	0.00
Fodder turnip	621	0.33	.	.	651	0.35	.	.
All fodder crops	**621**	**0.33**	**98**	**0.02**	**1,370**	**1.18**	**7,496**	**3.36**
All crops	**109,875**	**122.47**	**91,529**	**134.87**	**119,978**	**169.55**	**178,149**	**102.61**

Table 27 **Comparison of pesticide usage on grassland and fodder crops in Northern Ireland 1989-2003, area treated (spray hectares), weight applied (kilogrammes) and the area grown (hectares).**

	Survey year							
	1989		1993		1997		2003	
Pesticide type	**Area (sp ha)**	**Weight (kg)**	**Area (sp ha)**	**Weight (kg)**	**Area (sp ha)**	**Weight (kg)**	**Area (sp ha)**	**Weight (kg)**
Fungicides	251	235	180	59	421	161	7,933	2,417
Herbicides	73,637	120,551	85,151	134,680	109,253	168,545	149,630	97,976
Insecticides	103		76		37			
Carbamates	.	.	.	.	.	.	.	.
Organochlorines	.	.	.	.	8	4	.	.
Organophosphates	91	51	.	.	.	.	415	379
Pyrethroids	258	4	.	.	.	.	558	14
All insecticides	349	55	.	.	8	4	974	393
Growth regulators	.	.	.	.	176	42	1,870	1,369
Seed treatments	35,635	1,624	6,199	129	10,121	793	17,741	458
All pesticides	**109,874**	**122,465**	**91,529**	**134,869**	**119,978**	**169,545**	**178,148**	**102,613**
Area grown (ha)	***1,048,919***		***948,400***		***1,153,138***		***1,191,622***	

Table 28 **The proportional differences (%) of pesticide usage on grassland and fodder crops in Northern Ireland compared to 1989, 1993 and 1997.**

	Survey year comparison					
	1989 cf 2003		1993 cf 2003		1997 cf 2003	
Pesticide type	**Area**	**Weight**	**Area**	**Weight**	**Area**	**Weight**
Fungicides	3061%	929%	4307%	3997%	1784%	1401%
Herbicides	103%	-19%	76%	-27%	37%	-42%
Insecticides	179%	615%	.	.	12075%	9725%
Growth regulators	.	.	.	.	963%	3160%
Seed treatments	-50%	-72%	186%	255%	75%	-42%
All pesticides	**62%**	**-16%**	**95%**	**-24%**	**48%**	**-39%**
Area grown (ha)	***14%***		***26%***		***3%***	

Northern Ireland Pesticide Usage Survey Published Reports Appendix 1

Report No.	Report title	ISBN
99	Grassland & Fodder Crops 1989	1-855 27 079 X
105	Arable Crops 1990	1-855 27 130 3
106	Soft Fruit Crops 1990	1-855 27 149 4
109	Vegetable Crops 1991	1-855 27 137 0
110	Protected Crops 1991 (edible & ornamental)	1-855 27 283 0
111	Mushroom Crops 1991	1-855 27 150 8
117	Arable Crops 1992	1-855 27 193 1
118	Top Fruit Crops 1992	1-855 27 194 X
124	Grassland & Fodder crops 1993	1-855 27 221 0
131	Forestry 1993	1-855 27 282 2
132	Arable Crops 1994	1-855 27 314 4
139	Vegetable Crops 1995	1-855 27 346 2
140	Mushroom Crops 1995	1-855 27 347 0
146	Arable Crops 1996	1-855.27.469.8
147	Top fruit 1996	1-855.27.470.1
156	Grassland and Fodder Crops 1997	1-855.27.506.6
157	Sheep Treatments 1997	1-855.27.425.6
167	Soft Fruit 1998	1-85527.540.6
168	Arable Crops 1998	1-85527.536.8
169	Vegetable Crops 1999	1-85527.561.9
170	Mushroom Crops 1999	1-85527.549.X
177	Arable Crops 2000	1-85527.670.4
178	Top Fruit Crops 2002	1-855.27.618.6
194	Arable Crops 2002	1-85527.674.7
199	Hardy Nursery Stock Crops 2003	1-85527.789.1
201	Protected Ornamental Crops 2003	1-85527.739.5

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