

The Pesticide Users' Health Study

Survey of pesticide usage

Prepared by the **Health and Safety Laboratory**
for the Health and Safety Executive 2013

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The Pesticide Users Health Study is a cohort of nearly 66,000 commercial pesticide users, certified under the 1986 Control of Pesticide Regulations, who had agreed to participate in HSE's programme of research into their health. A survey to assess the history of pesticide usage among members of this cohort, and to assess the level of self-reported ill health associated with pesticide exposure, was undertaken in two waves during 2004 and 2006.

The response rate (14%) to the questionnaire was very low; this may be partly attributable to a general decrease in survey response rates and to the fact that the main wave of the survey was undertaken at a particularly busy time of year. Respondents listed nearly 2,500 unique trade names and 677 active ingredients. The most common areas of pesticide usage were amenity weed control and the treatment of cereals. Individuals who were often exposed to pesticide concentrate were four times more likely to report 'ill health' associated with pesticide use than those exposed to diluted products; additionally individuals who had used pesticides in jobs lasting more than 15 years were more likely to report 'ill health' than those working in jobs lasting less than 5 years.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy.

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First published 2013

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ACKNOWLEDGEMENTS

The author wishes to thank Adrian Cassidy, the HSE customer, for his help, support and enthusiasm for this work and the Pesticide Users' Health Study.

The author also wishes to thank colleagues in the Mathematical Sciences Unit at HSL for their contributions - Claire Collins, Rosemary Gagen-Hill, Carl Gartside, Anna Buttrill, Lorraine Gavin and Claudia Tarr in the Data Entry Team, Simon Rice for his work on the database, and Anne-Helen Harding and Gillian Frost for their support and advice.

Lastly, thanks to Chris Boorman, the Project Manager, for all his hard work and support.

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EXECUTIVE SUMMARY

Background

The Pesticide Users' Health Study (PUHS) was established in 1998 by the Health and Safety Executive to investigate concerns about chronic ill health, which may arise as a result of occupational exposure to pesticides. Individuals who gain certificates of competency in pesticide usage with the City & Guilds Land Based Services (formerly City & Guilds NPTC) are invited to be part of the study. The PUHS database contains information on around 66,000 individuals.

In 1996, before the PUHS database was constructed, a sample of 4,000 individuals identified by City & Guilds Land Based Services were asked about their job history, pesticide usage, health and other relevant factors. The questions on job history and pesticide usage formed the basis of the Survey of Pesticide Usage which was sent to all those on the PUHS database in two phases in 2004 and 2006.

Objectives

The main objectives were to use the responses to the Survey of Pesticide Usage to

- obtain a full job history for those on the PUHS database,
- summarise the extent and nature of current and historical pesticide usage, and
- assess the level of self-reported ill health associated with pesticide exposure among respondents.

Main Findings

Only 14% of individuals responded. This low response rate may be due to a general decrease in response rates to surveys. However some responders also commented that the survey had been sent in the summer, at a time when they were particularly busy.

About 90% of responders had used pesticides, confirming that a large proportion of individuals on the City & Guilds Land Based Services database were actively employed, or had been employed, in pesticide usage.

The most common areas of pesticide usage were amenity weed control and the treatment of cereals.

Responders listed 2,496 unique trade names and 677 unique active ingredients. Some responders commented that the level of detail requested on pesticides and their usage was too high.

For each job, participants were asked if they had ever knowingly been made ill by exposure to pesticides. Individuals who were often exposed to pesticide concentrate were four times more likely to report "ill health" compared to individuals who were exposed to dilute concentrate (Odds ratio 3.97, 95% confidence interval 2.22 to 7.10). Moreover, we observed a significantly increased risk of "ill health" with increasing duration of pesticide exposure. For example, individuals who had used pesticides in a job lasting for more than 15 years were twice as likely to report "ill health" as those who had used pesticides in a job lasting for less than 5 years (Odds ratio 1.89, 95% confidence interval 1.53 to 2.28).

Recommendations

Given the observed association between pesticide exposure and elevated risk of “ill health”, it will be important to explore this relationship further in pesticide users. Therefore, a survey of general health is required to assess possible links between pesticide exposure and chronic ill health.

Any future surveys should consider using a more structured approach to assessing detailed pesticide exposure than was employed by the current survey, particularly for historical exposures. The survey respondents commented negatively on the detail requested, and this was likely to be a factor in the poor response.

A broad range of health conditions and symptoms could be examined in a survey, while more detailed information could be obtained from Hospital Episode Statistics.

Further surveys on the PUHS should be carried out in the winter.

1 INTRODUCTION

A pesticide is a substance, or mixture of substances, used to kill an undesirable plant, fungal or animal pest. This encompasses a broad range of products and includes herbicides, fungicides, insecticides, rodenticides, wood preservatives and many other substances.

Pesticides have been used for many centuries. Inorganic substances such as sulphur, mercury and arsenic were used first: in 1000BC Homer referred to the use of sulphur to fumigate homes, and in 900AD the Chinese were using arsenic to control pests. By the late nineteenth century, plant-derived compounds such as pyrethrum and rotenone, were being used as pesticides. In the early 1900s, inorganic and biological substances were developed and used. During World War II, several insecticides and herbicides, including the organochlorine DDT, were developed and their use became widespread after the war.

Following concerns over the use of organochlorine insecticides, the UK Government began official surveys of pesticide usage on a variety of agricultural and horticultural crops in 1965. The Food and Environment Protection Act was introduced in the UK in 1985 and the registration and monitoring of pesticides became a legal requirement. The Pesticide Usage Survey is carried out by The Food and Environment Research Agency (FERA) and collects data on pesticides used in agriculture, horticulture and food storage. Reports on the surveys can be found at FERA's website^a.

Since 1989, anyone applying pesticides on a commercial basis must first gain a certificate of competence in their safe use. The City & Guilds Land Based Services (formerly City & Guilds NPTC) in Stoneleigh is a national awarding body within the land-based sector and is part of the City & Guilds Group. One of the many roles of City & Guilds Land Based Services is to maintain a database of individuals who hold a certificate of competence in the use of agricultural pesticides.

Since pesticides are designed to be toxic to specific living organisms, there are concerns that some may have levels of human toxicity also. In the 1990s, the Health and Safety Executive (HSE) acknowledged that more information was required about the extent and nature of pesticide-related ill health, particularly chronic conditions which may develop after many years of pesticide exposure.

In 1996, the Epidemiology and Medical Statistics Unit (EMSU) at HSE conducted a feasibility study into using the individuals on the City & Guilds Land Based Services database as a cohort who could be contacted regarding health and pesticide usage. As part of the feasibility study in 1996, a survey of pesticide usage was carried out on a sample of 4,000 individuals. Miles Thomas from the Central Science Laboratory (CSL, now FERA) and the project team at HSE designed the survey. The survey found that 92% of responders had used pesticides at some time during their working life, 74% of these had used them within the previous year. It also found that 18% had used pesticides on 40 days or more in the past year. From the survey it was clear that duration of exposure was highly variable and there were a large number of different pesticides being used. In 1998, the PUHS (Pesticide Users' Health Study) database was constructed to hold data on individuals who had agreed to be contacted by HSE and was designed to incorporate questionnaires and data from further surveys and studies. Following the set up of the PUHS database, a similar questionnaire was sent, in two phases, to the whole cohort of nearly 66,000 individuals. The main aim of the PUHS Survey of Pesticide Usage was to evaluate the extent and nature of current and historical pesticide usage for workers on the

^a [Hhttp://www.fera.defra.gov.uk/plants/pesticideUsage/index.cfm](http://www.fera.defra.gov.uk/plants/pesticideUsage/index.cfm)

PUHS database. The plan was to then link detailed information on individuals' exposure to pesticides with the study participants' health outcomes.

In February 2005 the database was transferred from EMSU to the Health and Safety Laboratory (HSL) in Buxton. Individuals on the PUHS database were flagged at the National Health Service Central Register (NHS CR), so that HSL would be notified of any cancer or death registrations among the pesticide users on the database. A report on mortality and another on cancer incidence are in preparation. The mortality report includes a discussion on the role of pesticides and describes a review of the published literature on associations between exposure to pesticides and ill health. Previous studies have suggested links between pesticide exposure and many health effects including Farmers' lung disease (Hoppin *et al.*, 2007a), chronic obstructive pulmonary disease (Hoppin *et al.*, 2007b), several neurological symptoms (from Parkinson's disease (Dick *et al.*, 2007) to less specific symptoms such as headaches and dizziness (Alavanja *et al.*, 2004)) and a variety of types of cancer, such as leukaemia (Van Maele-Fabry *et al.*, 2007, Van Maele-Fabry *et al.*, 2008) and prostate (Van Maele-Fabry *et al.*, 2006). Inconsistent evidence exists for associations with other health outcomes, such as non-Hodgkin's lymphomas (Alexander *et al.*, 2007a) and multiple myeloma (Alexander *et al.*, 2007b). It is important to note that association does not imply causality. Since pesticide users often experience exposure to a range of potential risk factors that may be causal, other known risk factors must be ruled out before a positive association between pesticide exposure and ill health can be demonstrated.

The main finding of the mortality data analysis is that the PUHS cohort had significantly lower all cause mortality than the British population. Specific causes of death (including individual cancers, respiratory diseases and neurological diseases) were examined but these were also generally lower than in the British population. This suggests the presence of a healthy worker effect, i.e. that those employed in pesticide usage will tend to be physically healthier than the general population, or it may reflect a healthy volunteer effect, or a combination of these effects.

This report presents the results from the PUHS Survey of Pesticide Usage including details on the PUHS cohort, the Survey of Pesticide Usage design, the response rate and the statistical methods used. Finally, several recommendations for further research of the PUHS cohort in relation to chronic ill health are made.

2 METHODS

2.1 THE COHORT

The City & Guilds Land Based Services maintains a database of individuals who hold one or more certificates of competence in the use of agricultural pesticides. On the City & Guilds Land Based Services registration form, there is an “opt-in” question, whereby individuals can consent to City & Guilds Land Based Services giving their details to HSE so that they are included in HSE research into occupational health.

In 1996 EMSU initiated a feasibility study on a sample of 4,000 individuals from the City & Guilds Land Based Services database to establish whether a database of licensed agricultural pesticide users could be used to investigate the extent and nature of pesticide-related ill health. Individuals were asked about their pesticide usage, health and other relevant factors. In 1998, the study concluded that the City & Guilds Land Based Services database would be an excellent tool for locating current pesticide users and provided a suitable population on which to base epidemiological studies into the effects of pesticide use (EMSU, 1998).

2.2 THE PESTICIDE USERS HEALTH STUDY DATABASE

In 1999, those who agreed to contact from HSE were entered on the Pesticide Users' Health Study (PUHS) database. The database was updated in 2003 and transferred to HSL in 2005. The PUHS database contains the personal details of 65,993 individuals including:

- Full name
- Maiden/previous name
- Sex
- Date of birth
- Address
- Employer name, background and address
- Test details: certificate received, date, centre name, county
- National insurance number
- National health service number

Note that information on occupation was not available. Most individuals were matched and flagged (n=63,505, 96%) at the National Health Service Central Register (NHS CR) or the General Register Office for Scotland (GROS). Quarterly reports are received from NHS CR and GROS notifying HSL of any cancer or death registrations for the flagged individuals. A separate report on the standardised mortality rates for this cohort has been written (Brown, 2009).

2.3 SURVEY OF PESTICIDE USAGE

While the information provided by City & Guilds Land Based Services is useful, there are no details about job history, pesticides used or levels of occupational exposure. As part of the feasibility study in 1996, EMSU developed a questionnaire on pesticide usage, which requested information on:

- Job history (i.e. current and all previous jobs)
- Years pesticides were used in each job held
- Main areas of pesticide work in each job
- Working practices (handling of concentrated/dilute products; use of personal protective equipment)
- Pesticide products used in each job
- Smoking habits

About 50% of the 4,000 individuals surveyed responded. It was found that respondents had a wide range of pesticide usage experience, in terms of type and number of pesticides used.

After the PUHS database on 65,993 individuals had been established, the cohort was surveyed on pesticide usage in two batches. In 2004 EMSU posted questionnaires to a random sample of approximately 15,000 cohort members on the database, and in 2006 HSL completed the posting to the remaining individuals traced by NHSCR.

All completed questionnaires were entered on a database by one of six members of the Data Entry Team within the Mathematical Sciences Unit at HSL in 2009. To check data entry quality, a random sample of 251 questionnaires was selected and entered onto a separate database, and the responses for the first three questions were compared. Matching rates of 96%, 93% and 95% were achieved.

Table 1 gives details of the numbers that responded, did not wish or were unable to take part, and the number of questionnaires, which were returned but not completed (i.e. post office returns, individual unknown at address or individual had moved and no forwarding address was available).

Table 1 Responses to survey

Response	First wave		Second wave	
	Frequency	Percentage	Frequency	Percentage
Returned questionnaire, completed	2,635	17.6%	6,659	13.5%
Returned, did not reach individual	22	0.1%	441	0.9%
Not able/want to take part	25	0.2%	206	0.4%
No response	12,225	81.8%	40,710	82.5%
Deceased	43	0.3%	1,348	2.7%
Total	14,950	100.0%	49,364	100.0%

The overall response rate of 14.8% was disappointingly low, particularly compared to the 50% response rate achieved in the feasibility study. Participation rates in epidemiologic studies have been decreasing over the past 30 years, particularly in recent years (Galea and Tracy, 2007). The large difference in response rates between the feasibility study and the main study would only be partly attributable to this trend given the relatively small time difference between the two surveys. A comparison of responders/non-responders (Table 2) shows responders slightly older than non-responders, and the proportion of males was slightly higher among those who responded. Table 3 shows that those with three or more certificates of competency were more likely to respond than those with only one or two certificates.

Table 2 Comparing responders and non-responders by age and sex

	Responders	Non-responders
<i>Age</i>		
Number	9,293	56,696
Average	51.8 years	48.1 years
Standard deviation	12.4 years	11.7 years
Median	50.9 years	45.9 years
<i>Sex</i>		
Number of males	8,786	53,167
Number of females	508	3,532
% males	94.5%	93.8%

Table 3 Comparing responders and non-responders by numbers of certificates

No. of certificates	No. with certificate	No. completed questionnaires	% response
1	8,141	844	11.7%
2	48,721	6,792	10.4%
3	6,526	940	14.4%
4	1,645	303	18.4%
5 or more	849	224	26.4%

2.4 STATISTICAL METHODS

Responses to the survey questions were summarised using frequency tables and percentages. Histograms were also used to illustrate the distribution of responses for some questions.

For each job, participants were asked whether they had knowingly been made ill by exposure to pesticides. Individuals who were made ill by exposure to pesticides (“cases”) were compared to a “healthy” control group using logistic regression. The logistic regression analysed each job reported by an individual separately. Non-independence of multiple responses by individuals was taken into account in the analysis by clustering the jobs by individual using robust standard errors. Ill health is often confounded by age, sex and smoking and their relationship with ill health was examined first. To quantify risk of ill health by pesticide exposure, four variables were considered: number of years used pesticides, number of hours per year, number of days per year and the handling of pesticide concentrate. Logistic regression models fitted to these variables were adjusted for age, sex and smoking. All analyses were undertaken in Stata v10.1.

3 RESULTS

3.1 SUMMARY OF PESTICIDE USAGE

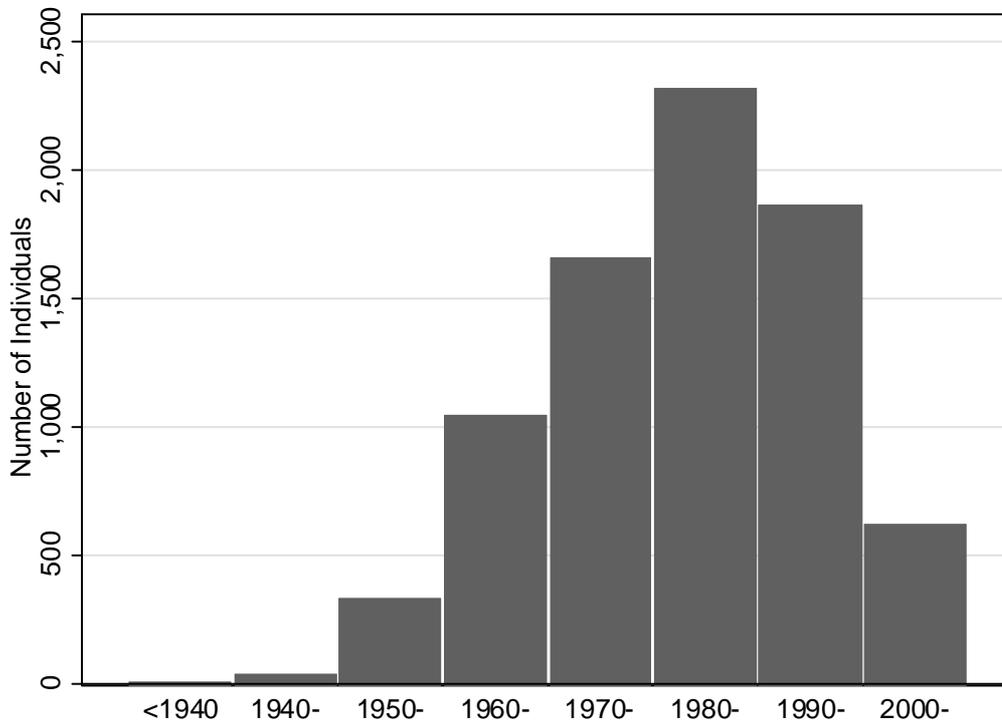
The first question in the survey (Appendix 3) asked whether individuals have ever used pesticides in their work. There were 8,223 positive responses out of 9,157 (89.8%), similar to the 92% observed in the feasibility study by EMSU in 1998. Of those who had never used pesticides, 811 (10.7%) did not plan to use pesticides in the future.

Table 4 and Figure 1 show the decade of first pesticide usage.

Table 4 Decade of first pesticide usage

Time period of first pesticide usage	Number of individuals	Percentage
<1940	1	0.01%
1940-	38	0.5%
1950-	332	4.2%
1960-	1,042	13.2%
1970-	1,661	21.1%
1980-	2,316	29.4%
1990-	1,864	23.7%
2000-	618	7.9%

Figure 1 Decade of first pesticide usage



3.2 SUMMARY OF PESTICIDE EXPOSURE BY JOB

Survey participants were asked about their pesticide exposure in each job, current and previous. Data on 17,227 jobs were received for 8,244 individuals.

3.2.1 Duration of exposure

Figure 2 shows the number of years pesticides were used for 11,731 jobs. (The response rate to this question was 68%, which is quite low). The mean was 12.2 years (SD = 11.0 years), with a median of 9 years. This information is also summarised by individual in Figure 3. For 8,244 individuals, the total number of years of exposure had a mean of 17.3 years (SD = 12.6 years) and median of 16 years.

Figure 2 Histogram of number of years used pesticides by job

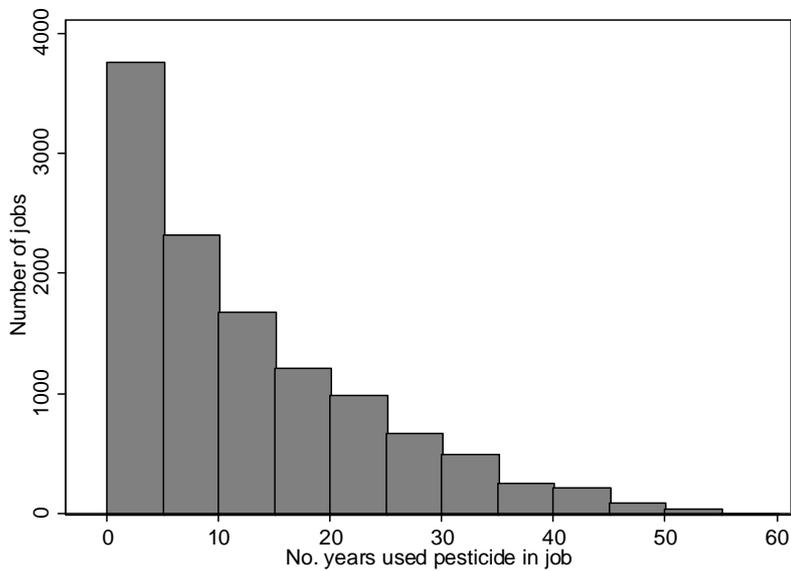
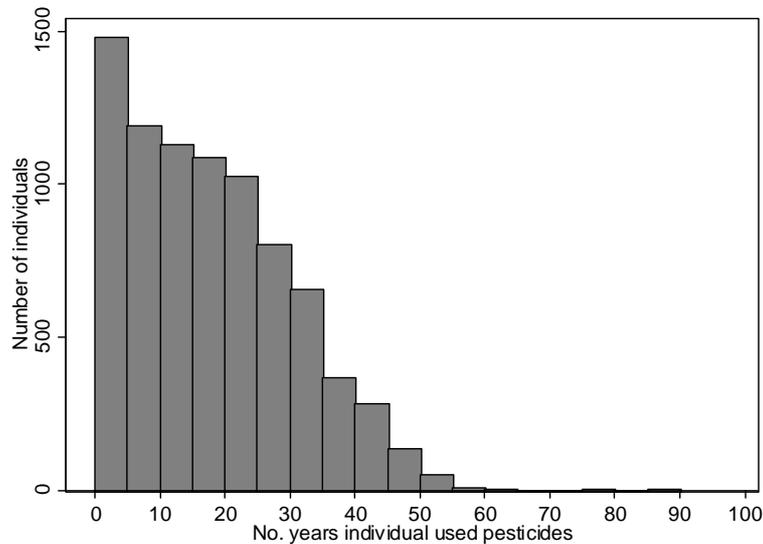


Figure 3 Histogram of total years used pesticide for individuals



The survey asked how many hours per year pesticides were used in the job and on how many days. The responses to both these questions were very skewed, particularly hours per year. For 9,211 jobs, a mean of 146.2 hours per year was found, with SD of 311.4 and median of 40 hours per year. For 10,484 jobs, an average of 38.4 days per year was calculated, with SD of 55.8 and median of 20 days per year.

3.2.2 Main areas of pesticide work

Responders were asked to select which of the descriptions below summarised their main areas of pesticide work. Note that responders could tick more than one box. Table 5 shows that the most common choices were “Amenity weed control” and “Cereals”. Table 6 summarises the categories ticked and shows that 27% worked in more than one area.

Table 5 Main areas of pesticide work

	Number of jobs	Percentage of jobs
<i>Agriculture</i>		
Cereals	3,941	22.9%
Oilseeds	2,245	13.0%
Potatoes	1,427	8.3%
Sugar beet	1,135	6.6%
Grassland	2,715	15.8%
Other arable crops	1,462	8.5%
Hops	123	0.7%
<i>Horticulture</i>		
Orchard	582	3.4%
Soft fruit	494	2.9%
Mushrooms	76	0.4%
Outdoor veg	738	4.3%
Glasshouse	1,427	8.3%
Hardy nursery stock	1,070	6.2%
Ornamental	1,416	8.2%
<i>Other</i>		
Golf courses	2,403	13.9%
Amenity weed control	5,019	29.1%
Forestry	1,496	8.7%
Aquatic	289	1.7%
Other	1,851	10.7%

Table 6 Categories of pesticide work

	Number of jobs	Percentage of jobs
Agriculture only	3,206	26.3%
Horticulture only	1,122	9.2%
Other only	4,583	37.5%
Agriculture + Horticulture	452	3.7%
Agriculture + Other	921	7.6%
Horticulture + Other	1,566	12.8%
Agriculture + Horticulture + Other	358	2.9%
Ticked at least one box	12,208	100.0%

Out of 11,995 responses, 2,572 (21.4%) said they normally worked as a contractor in this job.

For each job, the survey asked whether individuals personally handled pesticide concentrate. Of 12,002 responses, 6,742 (56.2%) said “yes, often”, 4,653 (38.8%) said “yes, sometimes” and 607 (5.0%) said “no, only dilute product”. Table 7 summarises two questions on the use of personal protective equipment in their current job for concentrate and dilute products. The column “Dilute products” included individuals responding “yes, frequently”, “yes, often” and “no, only dilute product” to the question on handling pesticide concentrate (see question 21, Appendix 3). The “Concentrate products” column excluded those who responded, “no, only dilute product”.

Table 7 Personal Protective Equipment and Concentrate/Dilute products

Personal Protective Equipment	Number of responses for all jobs for handling	
	Concentrate products	Dilute products
Gloves	5,512	5,168
Coverall/Apron	4,913	4,587
Rubber boots	4,631	4,395
Face shield	4,433	2,780
Respirator	1,406	1,039
Other	310	341
TOTAL	21,205	18,310

There were a further 310 responses for concentrate products and 341 for dilute products where other PPE had been used. Many of these responses mentioned facemasks, waterproof suits and goggles.

For each job, individuals were asked if they worked with any of the following four categories of pesticides: sheep dips, non-agricultural pesticides (e.g. wood treatment), other veterinary medicines, rodenticides. Individuals could tick more than one box and the results are summarised in Table 8.

Table 8 Types of pesticides

Pesticide	Number of responses for all jobs
Rodenticides	2,562
Non-agricultural pesticides	1,656
Other veterinary medicines	1,643
Sheep dips	921

3.3 SUMMARY OF TYPES OF PESTICIDES

Responders were asked to list all the main pesticide products, by trade name or active ingredient, they had used in each job. The Data Entry Team at HSL used a reference list to enter these data to correct for any spelling errors.

There were 65,561 records on 7,240 individuals and 10,588 jobs. These comprised 2,496 unique trade names and 677 unique active ingredients. The mean number of pesticides listed *per job* was 6.2 (SD 8.4) with median of 4 pesticides and a range of 1 to 104 pesticides. The mean number *per person* was 9.1 (SD 10.9), with median of 6 pesticides and range of 1 to 141 pesticides.

The most commonly listed active ingredients were Glyphosate (12.4%) and Paraquat (4.2%). None of the other active ingredients accounted for more than 2% of the total. The most commonly listed trade names were “Roundup” (9.1%) and “Gramoxone 100” (3.4%) – other products accounted for less than 2% of total. The large number of different pesticides being used made it difficult to summarise the data any further.

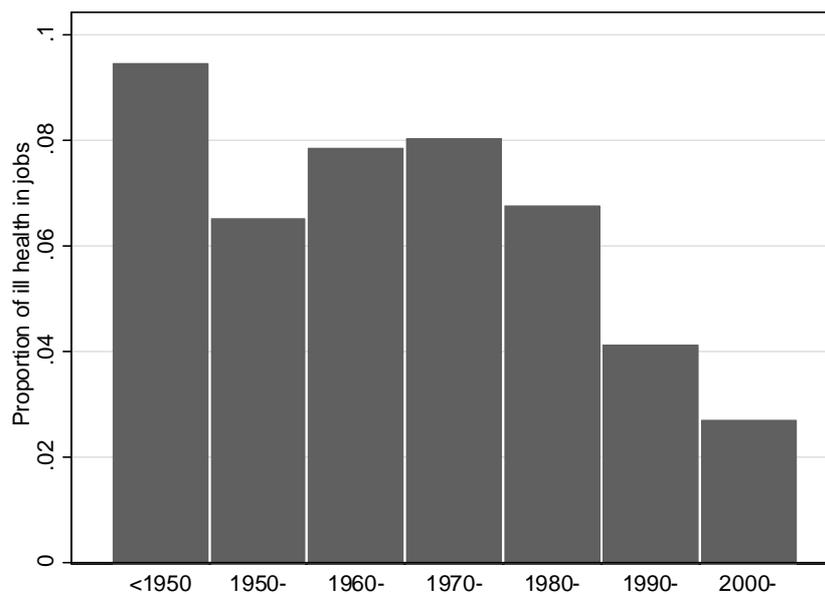
3.4 WORK-RELATED ILL HEALTH

For each job, individuals were asked “In this job, were you ever knowingly made ill by exposure to pesticides?” with possible responses “Yes” or “No”. This was the only health-related question.

The number of jobs where individuals thought they had been made ill by pesticide exposure was 729 out of 11,800 jobs (6.2%).

Figure 4 shows the proportion of self-reported occupational ill health by decade in which employment started in that job.

Figure 4 Proportion of self-reported occupational ill health by decade job started



3.5 SMOKING

Smoking is often a confounding factor in studies of ill health. Three questions were asked about smoking status. Of 8,073 responders, 1,126 (13.9%) were current smokers, 2,437 (30.2%) were former smokers, and, 4,510 (55.9%) said they had never smoked. Of those who had ever smoked (current or past), the mean number of years smoked was 19.4 years (SD 12.4 years) and the mean of the average number of cigarettes smoked per day was 15.5 (SD 9.3). Table 9 and Table 10 illustrate the distributions.

Table 9 Categories of number of years smoked

Number of years smoked	Number of responses	Percentage
≤ 10 years	1,152	33.3%
11 – 20 years	1,068	30.8%
21 – 30 years	684	19.7%
31 – 40 years	371	10.7%
>40 years	190	5.5%
TOTAL	3,465	100%

Table 10 Categories of number of cigarettes smoked per day

Number of cigarettes smoked per day	Number of responses	Percentage
≤ 5	542	16.2%
6 – 10	815	24.3%
11 – 15	552	16.5%
16 – 20	1,023	30.5%
21 – 25	109	3.2%
>25	310	9.3%
TOTAL	3,351	100%

3.6 ILL HEALTH AND PESTICIDE EXPOSURE

Before looking at ill health and pesticide exposure, possible confounders (age, sex and smoking) were examined. Survey participants described their job exposure history. Overall, 41% of respondents had only one job, but the remaining respondents had up to 11 different jobs. Consequently, age was summarised here as age at the start of each job. Smoking status is unknown during individual jobs and so was summarised as either “ever smoked” (so includes former and current smokers, see Section 3.5) or “never smoked”. The percentages and odds ratios are given in Table 11. The percentages of those reporting illness are very similar for both smoking categories.

Table 11 Self-reported occupational ill health by age, sex and smoking status

Variable	No. jobs made ill	No. jobs not made ill	% jobs made ill	Odds ratio	95% CI
<i>Age (years)</i>					
<20	280	3,320	7.8%	1.00	
21 – 30	286	3,933	6.8%	0.86	0.72 – 1.03
31 – 40	95	2,003	4.5%	0.56	0.44 – 0.71
41 – 50	41	1,098	3.6%	0.44	0.32 – 0.62
> 50	17	540	3.1%	0.37	0.23 – 0.61
<i>Sex</i>					
Females	28	490	5.4%	1.00	
Males	701	10,581	6.2%	1.16	0.76 – 1.78
<i>Smoking status</i>					
Never smoked	392	6,023	6.1%	1.00	
Ever smoked	320	4,817	6.2%	1.02	0.86 – 1.21

To quantify risk of ill health from occupational exposure to pesticides, four variables were considered: number of years used pesticides, number of hours per year, number of days per year and the handling of pesticide concentrate. The number of years pesticides were used was divided into tertiles at 5 and 15 years. The number of hours per year and days per year spent using pesticides were similarly split into tertiles at 20 and 100 hours per years, and at 10 and 30 days per year. The lowest tertiles were used as the reference category in logistic regression models. For the handling of pesticide concentrate, the usage of a dilute product was utilised as a reference group. The models were adjusted for age, sex and smoking and the results are shown in Table 12.

Table 12 Self-reported occupational ill health by pesticide exposure

Variable	No. jobs made ill	No. jobs not made ill	% jobs made ill	Adjusted Odds ratio [†]	95% CI
<i>Duration of job involving pesticide usage (years)</i>					
≤5	177	4,030	24.2%	1.00	
5 – 15	207	3,288	28.4%	1.40	1.14 – 1.74
>15	345	3,753	47.3%	1.89	1.53 – 2.28
<i>Hours per year</i>					
≤20	117	2,949	22.2%	1.00	
20 – 100	173	3,055	32.8%	1.41	1.09 – 1.82
>100	238	2,321	45.1%	2.44	1.91 – 3.12
<i>Days per year</i>					
≤10	130	3,625	20.8%	1.00	
10 – 30	215	3,166	34.5%	1.85	1.47 – 2.32
>30	279	2,656	44.7%	2.86	2.29 – 3.58
<i>Handle pesticide concentrate</i>					
No, only dilute	12	559	2.1%	1.00	
Yes, sometimes	160	4,356	3.5%	1.62	0.89 – 2.95
Yes, often	551	5,592	8.4%	3.97	2.22 – 7.10

[†] Odds ratios adjusted for age, sex and smoking status

Each of the models reported in Table 12 shows an increase in reporting of ill health with increasing duration of jobs involving pesticide exposure. For example, those who have used pesticides in their jobs for more than 15 years are almost twice as likely to report “ill health” compared to those who have used pesticides for less than 5 years.

4 CONCLUSIONS

4.1 OBSERVATIONS FROM SURVEY

In 1996, the Epidemiology and Medical Statistics Unit at HSE conducted a pilot study on pesticide usage in licensed agricultural pesticide users from a sample of 4,000 individuals on the City & Guilds Land Based Services's database. The response rate was 50%, though comments were made on the survey being too long and being sent out when workers were very busy. When the survey was sent to the 65,993 individuals on the PUHS database, the response rate was much lower at 14%. This may partly be attributable to the global trend of decreasing response rates to surveys (Galea and Tracy, 2007). As in the initial study some responders commented on the timing of the survey but also that the information requested was very detailed; the poor response rate was probably also attributable to these factors. The low response rate may limit the generalisability of the results, although the differences in age and sex distribution between responders and non-responders were negligible.

About 90% of responders had used pesticides, confirming that a large proportion of individuals on the City & Guilds Land Based Services database were actively employed, or had been employed, in pesticide usage. The median number of years exposed in all jobs was 16 years, with a range of 0 to 85 years. The median duration of exposure was 40 hours per year and 20 days per year.

The commonest main areas of pesticide usage reported were amenity weed control and cereals. Responders listed 2,496 unique trade names and 677 unique active ingredients. The wide variety of products available for pesticide usage made it very difficult to summarise or to link with any ill-health variables.

The proportion of respondents who were current smokers was very small (14%), and the majority of respondents were never smokers (56%). As a comparison, the proportion of current smokers among adults aged over 16 years in Britain, was no lower than 26% during the 1990s and was 24% in 2005 (NHS IC, 2009). These statistics suggest that as a group, these workers were at lower risk of the smoking-related diseases, including lung cancer and cardiovascular disease.

Currently, the only health-related information that is available on this cohort of pesticide users is obtained from the NHS Central Register in the form of cancer and death registrations among the PUHS cohort participants. The mortality analysis indicated that the PUHS cohort has significantly lower all cause mortality than the general British population. However, occupational exposure to pesticides has long been associated with chronic ill health, particularly neurological disorders such as Parkinson's Disease. From the limited health data that was collected in this survey of pesticide usage, a significantly elevated risk of "ill health" was associated with occupational exposure to pesticides, and a positive trend with increasing exposure was observed. Unfortunately, the current data do not allow for more detailed analysis, and further clarification of symptoms or disease/condition would be required.

About 3,000 responders added a final comment in the survey form. Many of them commented on the difficulty in completing the form accurately due to vast amount of information required. The PUHS Survey of Pesticide Usage has shown the wide variation in the types of chemical used, and in the number of pesticides used by an individual.

4.2 RECOMMENDATIONS

A survey of general health among licensed pesticide users should be undertaken in order to investigate potential ill-health issues related to occupational exposure to pesticides. This would help in identifying any important associations with chronic symptoms and conditions, which cannot be detected through the cancer incidence and mortality data.

In the new survey, the questionnaire should provide a simpler, more structured approach to collecting detailed exposure data than in the current survey; this will help respondents and ensure that the data provided are in a consistent format. The survey respondents commented negatively on the detail requested, and this was likely to be a factor in the poor response. If the new survey brings to light any health effects associated with particular pesticide types or activities, then a more detailed follow-up study should investigate these in greater depth. By sending the survey to workers in winter when they are not spraying pesticides, the response rate may also increase.

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APPENDIX 1 COVER LETTER FOR PUHS SURVEY OF PESTICIDE USAGE

«Title» «Initial» «Surname»
«ADD1»
«ADD2»
«ADD3»
«ADD4»
«ADD5»
«ADD6»

8 March 2004

Our Ref: Survey no «SURVEYNO»

Dear «Title» «Surname»

PESTICIDE USERS' STUDY: PESTICIDE USAGE SURVEY

I am writing to ask for your help with a major study by the Health and Safety Executive (HSE) to monitor the health of people who have worked with pesticides.

You may recall that on your application form for a Certificate of Competence in the Use of Pesticides you agreed that the National Proficiency Tests Council (NPTC) could pass your details to HSE to help us with research into pesticide safety. As a result you became part of our Pesticide User's Study.

We have already shown that the data provided by the NPTC will be very useful for research purposes and HSE is now committed to monitoring the health of Certificate holders like you over a number of years. In order to do this properly, we need more information, **about which pesticides you have used, and when and how you used them in the whole of your working life**. So now we are asking you for some more help with this Study.

We are conducting a pesticide usage survey and I would therefore be most grateful if you could complete and return the enclosed questionnaire even if, despite having a certificate, you have never used pesticides in the course of your work.

The enclosed information sheet gives more details, including how information about you will be treated confidentially.

I realise that now may be a busy time of year for you but it would help get the study off to a really good start if we could have as many questionnaires as possible back by the **end of March**.

If you have any queries please do not hesitate to contact us, by telephone, email or letter as described in the attached sheet.

Thank you in advance for your help.

Yours sincerely,



Paul Buckley
Principal Investigator
HSE Pesticide Users' Health Study

APPENDIX 2 SURVEY INFORMATION LEAFLET

Pesticide Users' Study: Pesticide Usage Survey Further information for participants

Why is HSE carrying out this survey?

The Health and Safety Executive (HSE) is committed to reducing the risks people face through work activities. Many people work with pesticides or live in areas where they are used and there has sometimes been public concern about whether they might be a risk to people's health.

The medical evidence available to HSE suggests that when used properly pesticides pose no significant risks to health. However we are aware that there are some gaps in our knowledge.

This survey, which is part of HSE's Pesticide User's Study, will look at users' work with pesticides now, and in the past. We also want to find out about the types of pesticide used and the time spent using them.

We will use this information, with information about users' health, to provide a further check on pesticide safety.

How is HSE able to contact pesticide users and learn about their health?

The National Proficiency Tests Council, (NPTC), keeps records of users of agricultural pesticides who have Certificates of Competence under the Control of Pesticides Regulations 1986. You and many other pesticide users gave permission for HSE to access the information relating to you for the purpose of medical research into pesticide use. This is how you became part of the Pesticide User's Study and this is how we have identified you as someone who can help us with this new part of our research.

This is how we are also able to track the health of pesticide users through the national health registers in the UK. This informs us of important health events in the lives of the individuals in the Study.

How many will be included in the new survey?

Over the next five years we will be approaching all pesticide users' who are on our records and asking them about various aspects of their work with pesticides. In the first phase of the survey we are asking 15,000 pesticide users' to complete the enclosed questionnaire.

Future research

If you agree to help HSE with this new survey then we will want to contact you on further occasions in the future to ask you for updated information about the pesticides you have used and about safety precautions you have taken at the time. We might also contact you at some time in the future to ask you for more help with other research into pesticide health and safety.

We would always explain at these times what research we wanted to do, and exactly what you would have to do to help. You would always be able to choose at the time whether or not you wanted to help in this way.

We would like to remind you now that you can ask, if you wish, to withdraw from all or part of the Pesticide User's Study at any time by contacting us using the contact information given below.

Confidentiality

Any information you provide, or that the NHS registers send to HSE, will be treated as strictly confidential. HSE's research is registered under the Data Protection Act 1998 and your personal data will be protected by this law and by other law protecting the privacy of information obtained through the NHS.

HSE may seek the help of other expert researchers with our research. Other expert researchers may ask HSE for permission to use the information we have collected about you in the Pesticide Users' Study. However, we will not pass to anyone else any information that can be linked to you as an individual unless you have given us your permission to do so.

We must publish the findings of our research if they are to help improve health and safety. **But personal information that could be linked to you, as an individual, will not be made public.**

How do I get further information?

We hope that this leaflet makes our intentions clear and that you will agree to participate in the survey.

If you have any difficulty in completing the questionnaire, or feel that you need to ask any further questions, a freephone number and email address are provided. This will be available at all times but outside office hours and at other times when a member of the team is not available it will connect you to an answering machine. All you need to do is leave your name and number and a member of the study team will attempt to speak to you personally within two working days.

Freephone 0800 592450

Email: Pesticide.Study@hse.gsi.gov.uk

Pesticide User's Study
Epidemiology and Medical Statistics Unit
Room 244 Magdalen House
Stanley Precinct
Bootle
Merseyside
L20 3QZ

APPENDIX 3 SURVEY QUESTIONNAIRE

Survey No:

Pesticide users' health study: survey of pesticide usage

How to complete this questionnaire

This questionnaire asks about which pesticides you have used at work, and how and when you used them. It is vital that we have this information so that we can study how pesticides may affect the health of people who use them.

- Please complete the questionnaire as fully as possible, even if you have not used many pesticides or do not use them at the moment.
- We have kept the questions as simple as possible and most just require 'tick' answers in the appropriate boxes.
- All information you give will be treated in strict confidence.




HEALTH & SAFETY EXECUTIVE * HEALTH AND SAFETY LABORATORY

We would like to know about your exposure to pesticides over the whole of your working life. By pesticides, we mean products such as herbicides (weed-killers), insecticides, fungicides, fumigants, and growth regulators.

1. Have you ever used pesticides in your work?

Yes Please go to question 3
 No Please go to question 2

2. Do you have any plans to use pesticides in your work in the future?

Yes Please go to question 25
 No Thank you. Now please return the questionnaire in the pre-paid envelope

3. When did you first use pesticides in your work? (Enter year first used)

4. Please list the approximate dates of all the jobs you have had in your working life, starting with the most recent.

	Year started	Year finished	Do/did you use pesticides in this job?
Current job (if any)	<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
Previous job No.1	<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
Previous job No.2	<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
Previous job No.3	<input style="width: 50px;" type="text"/>	<input style="width: 50px;" type="text"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

1

HEALTH & SAFETY EXECUTIVE * HEALTH AND SAFETY LABORATORY

The following questions (5-15) relate to your current job.
If you have no current job please go to question 16.

5. When did you start this job?

Year started

6. How many years in this job have you used pesticides?

Years (If you do not use pesticides in this job please enter and go to question 16)

7. On average, how many hours per year do you use pesticides in this job and on how many days?

hours per year
 on days per year } (Please answer both if possible, if not, whichever is easier)

8. Please tick the appropriate boxes which summarises your main areas of pesticide work (please tick all that apply)

Agriculture Cereals (wheat, barley, oats, rye, etc) <input type="checkbox"/> Oilseeds (oilseed rape, linseed) <input type="checkbox"/> Potatoes <input type="checkbox"/> Sugar beet <input type="checkbox"/> Grassland and / or fodder crops <input type="checkbox"/> Other arable crops <input type="checkbox"/> Hops <input type="checkbox"/>	Horticulture Orchard crops (apples, pears, plums, etc) <input type="checkbox"/> Soft fruit (strawberries, currants etc) <input type="checkbox"/> Mushrooms <input type="checkbox"/> Outdoor vegetables <input type="checkbox"/> Glasshouse crops (edible or ornamental) <input type="checkbox"/> Hardy nursery stock <input type="checkbox"/> Outdoor ornamental flowers and bulbs <input type="checkbox"/>	Other Golf courses, bowling greens, sports grounds <input type="checkbox"/> Amenity weed control: roads, pavements etc <input type="checkbox"/> Forestry <input type="checkbox"/> Aquatic <input type="checkbox"/> Other (please specify): <input style="width: 100px;" type="text"/> <input style="width: 100px;" type="text"/>
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2

HEALTH & SAFETY EXECUTIVE * HEALTH AND SAFETY LABORATORY

9. In this job, do you normally work as a contractor?

Yes No

10. In this job, do you personally handle pesticide concentrates?

Yes, often Please go to question 11
 Yes, sometimes Please go to question 11
 No, only dilute product Please go to question 12

11. What personal protective equipment do you normally wear when handling concentrate products? (Please tick all that apply)

Gloves Rubber boots Coverall/Apron Face shield
 Respirator Other (please state)

12. What personal protective equipment do you normally wear when using dilute products? (Please tick all that apply)

Gloves Rubber boots Coverall/Apron Face shield
 Respirator Other (please state)

13. In this job, have you ever knowingly been made ill by exposure to pesticides?

Yes No

14. In this job, do you work with any of the following? (Please tick all that apply)

Sheep dips Non-agricultural pesticides (e.g. wood treatment)
 Other veterinary medicines Rodenticides

3

The next question (15) asks for details of the pesticides you have used in your current job. Please note that:

- a separate entry should be made for each pesticide used - either the full trade name or the active ingredient, whichever is easier
- if you used a mixture of pesticides in a single application, each individual pesticide in the mixture should be listed separately
- please give both the total number of hours you use each pesticide in an average year and the number of days when you use it - or if you can only give one, whichever is easier for you
- you may find it helpful to refer to your pesticide records when answering this question

15. Please indicate which pesticide products you have used in this job and, on average, for how many hours you used them each year, and on how many days each year.

Trade name / Active ingredient	Hours per year	Days per year	For Official Use																	

The following pages relate to previous jobs where you have used pesticides. Please answer one set of questions (16-24) for each job. If you have not used pesticides in any previous job, please go to question 25

16. Previous job details (please refer to your answers to question 4)
 Previous job No. Year started Year finished

17. How many years in this job did you use pesticides?
 Years

18. On average, how many hours per year did you use pesticides in this job and on how many days?
 hours per year
 on days per year

(Please answer both if possible, if not, whichever is easier)

19. Please tick the appropriate boxes which summarises your main areas of pesticide work (please tick all that apply)

- | | | |
|--|--|---|
| Agriculture | Horticulture | Other |
| Cereals (wheat, barley, oats, rye, etc) <input type="checkbox"/> | Orchard crops (apples, pears, plums, etc) <input type="checkbox"/> | Golf courses, bowling greens, sports grounds <input type="checkbox"/> |
| Oilseeds (oilseed rape, linseed) <input type="checkbox"/> | Soft fruit (strawberries, currants etc) <input type="checkbox"/> | Amenity weed control: roads, pavements etc <input type="checkbox"/> |
| Potatoes <input type="checkbox"/> | Mushrooms <input type="checkbox"/> | Forestry <input type="checkbox"/> |
| Sugar beet <input type="checkbox"/> | Outdoor vegetables <input type="checkbox"/> | Aquatic <input type="checkbox"/> |
| Grassland and / or fodder crops <input type="checkbox"/> | Glasshouse crops (edible or ornamental) <input type="checkbox"/> | Other (please specify): <input type="text"/> |
| Other arable crops <input type="checkbox"/> | Hardy nursery stock <input type="checkbox"/> | <input type="text"/> |
| Hops <input type="checkbox"/> | Outdoor ornamental flowers and bulbs <input type="checkbox"/> | <input type="text"/> |

20. In this job, did you normally work as a contractor? Yes No
21. In this job, did you personally handle pesticide concentrate?
 Yes, often Yes, sometimes No, only dilute product
22. In this job, were you ever knowingly made ill by exposure to pesticides?
 Yes No
23. In this job, did you work with any of the following (Please tick all that apply)
 Sheep dips Non-agricultural pesticides (e.g. wood treatment)
 Other veterinary medicines Rodenticides

The next question (24) asks for details of the pesticides you have used in this job. Please note that:

- a separate entry should be made for each pesticide used - either the full trade name or the active ingredient, whichever is easier
- if you used a mixture of pesticides in a single application, each individual pesticide in the mixture should be listed separately
- please answer the question as fully as possible, even if you cannot remember all the pesticides you used in this job.

24. Please indicate the main pesticide products you used in this job:

Trade name / Active ingredient	For Official Use																				

Please use one loose leaf sheet for each previous job where you used pesticides.

16. Previous job details (please refer to your answers to question 4)
 Previous job No. Year started Year finished

17. How many years in this job did you use pesticides?
 Years

18. On average, how many hours per year did you use pesticides in this job and on how many days?
 hours per year
 on days per year

(Please answer both if possible, if not, whichever is easier)

19. Please tick the appropriate boxes which summarises your main areas of pesticide work (please tick all that apply)

- | | | |
|--|--|---|
| Agriculture | Horticulture | Other |
| Cereals (wheat, barley, oats, rye, etc) <input type="checkbox"/> | Orchard crops (apples, pears, plums, etc) <input type="checkbox"/> | Golf courses, bowling greens, sports grounds <input type="checkbox"/> |
| Oilseeds (oilseed rape, linseed) <input type="checkbox"/> | Soft fruit (strawberries, currants etc) <input type="checkbox"/> | Amenity weed control: roads, pavements etc <input type="checkbox"/> |
| Potatoes <input type="checkbox"/> | Mushrooms <input type="checkbox"/> | Forestry <input type="checkbox"/> |
| Sugar beet <input type="checkbox"/> | Outdoor vegetables <input type="checkbox"/> | Aquatic <input type="checkbox"/> |
| Grassland and / or fodder crops <input type="checkbox"/> | Glasshouse crops (edible or ornamental) <input type="checkbox"/> | Other (please specify): <input type="text"/> |
| Other arable crops <input type="checkbox"/> | Hardy nursery stock <input type="checkbox"/> | <input type="text"/> |
| Hops <input type="checkbox"/> | Outdoor ornamental flowers and bulbs <input type="checkbox"/> | <input type="text"/> |

And finally, it would help our future research into pesticide usage and health if you could answer the following questions.

25. Have you ever smoked (cigarettes, cigars or tobacco)?
 Yes, still smoke Please go to question 26
 Yes, but don't smoke nowadays Please go to question 26
 No, never smoked Please go to question 28
26. For how many years have/had you smoked? Years
27. On average how many cigarettes did/did you smoke per day?
 Per day
28. Are there other members of your family who live with you?
(please tick all that apply)
 Yes- spouse or partner
 Child(ren)
 Other
 No
29. Has your name changed (e.g. by marriage)?
 Yes Please specify
 No
30. Has your address changed from that shown on the covering letter?
 Yes Please specify
 No

31. Do you have a telephone number that we can use to contact you if necessary?
 Home
 Work For official use
32. Could you please give the name and address of a friend or relative, who does not live with you, whom we could contact to find out your address should you move in the future? *(Please let them know you have given us their name)*
 For official use
33. How long has it taken you to complete this questionnaire?
 Minutes For official use
34. Are there any other comments you would like to make?

Thank you for taking the time to complete this booklet. Please return it in the postage paid envelope provided.

The Pesticide Users' Health Study

Survey of pesticide usage

The Pesticide Users Health Study is a cohort of nearly 66,000 commercial pesticide users, certified under the 1986 Control of Pesticide Regulations, who had agreed to participate in HSE's programme of research into their health. A survey to assess the history of pesticide usage among members of this cohort, and to assess the level of self-reported ill health associated with pesticide exposure, was undertaken in two waves during 2004 and 2006.

The response rate (14%) to the questionnaire was very low; this may be partly attributable to a general decrease in survey response rates and to the fact that the main wave of the survey was undertaken at a particularly busy time of year. Respondents listed nearly 2,500 unique trade names and 677 active ingredients. The most common areas of pesticide usage were amenity weed control and the treatment of cereals. Individuals who were often exposed to pesticide concentrate were four times more likely to report 'ill health' associated with pesticide use than those exposed to diluted products; additionally individuals who had used pesticides in jobs lasting more than 15 years were more likely to report 'ill health' than those working in jobs lasting less than 5 years.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy.