Integrated Pest Management

Survey of Pesticide Use in British Columbia: 1995

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Executive Summary

In 1991, the British Columbia Ministry of Environment, Lands and Parks (MELP) (now Ministry of Environment [MOE]) established the objective of encouraging and promoting adoption of Integrated Pest Management (IPM). IPM methods reduce reliance on pesticides and eliminate unnecessary pesticide uses.

In 1992, MOE commissioned the first survey of pesticide sales and use records in British Columbia, using data from 1991. A second survey, by Norecol, Dames & Moore, Inc. (NDM), was commissioned to document pesticide sales and use in 1995 and to compare 1991 and 1995 data.

The objectives of the 1995 survey were to:

- obtain pesticide sales records for 1995, including domestic, veterinary and commercial pesticides;
- obtain pesticide use data for 1995 for anti-sapstain chemicals and wood preservatives;
- obtain pesticide use records for MOE's Lower Mainland region from annual summaries of use submitted by pest control services renewing licenses in the landscape use category; and
- compile the information into databases and summary tables so that the data could be compared to the results from the 1991 survey.

The 1995 study was somewhat more limited in scope than the survey of 1991. Instead of surveying pest control services in all regions, only pest control services located in the Lower Mainland and licensed in the landscaping category were included. As well, only Domestic pesticides sold through veterinarians were surveyed in 1995 rather than a broader range of Domestic pesticides. Slimicides, which were included in the 1991 survey, were not surveyed for 1995. With the exception of these omissions, the 1995 survey provided the first opportunity to monitor changes in pesticide use patterns.

The study included data gathering and data analysis. The data were compiled from existing sources, including: the Annual Summary of Reportable Pesticide Sales by licensed vendors; the Annual Summary of Pesticide Use by pest control services licensees; and the 1995 survey of anti-sapstain use conducted annually by Environment Canada. Data were also acquired through vendor and user surveys.

As in 1991, the 1995 survey included an evaluation of data quality. Errors and irregularities on both the sales and use reports were identified and summarized. Surveys were conducted to determine the methods used to calculate annual pesticide sales and use in order to evaluate the accuracy of the data.

The study results showed that in 1995, British Columbians purchased or used 8,674,920 kg of pesticide active ingredients. This excludes most Domestic label products, but does include Domestic products sold by veterinarians. Of this total, 7,687,656 kg (88.6%) were anti-microbials, consisting primarily of commercially-applied wood preservatives and anti-sapstain chemicals. Insecticides accounted for 354,212 kg (4.1%) of the total pesticides, herbicides accounted for 327,722 kg (3.8%) and 232,490 kg (2.7%) were fungicides. The remaining pesticides included fumigants, plant growth regulators, vertebrate control products, adjuvants and surfactants.

The total, province wide pesticide use included 254 active ingredients. Twenty of these active ingredients accounted for 95.5% of the pesticides sold or used during 1995. Creosote alone accounted for 67.7% of the pesticide use in the province. The wood preservative chromated copper arsenate (CCA) and the anti-sapstain didecyl dimethyl ammonium chloride (DDAC) accounted for 10.5% and 5.3% of all pesticides used, respectively. Other important active ingredients included: insecticidal mineral oil, representing 2.4%; borax (including all forms of borate and borax except sodium metaborate tetrahydrate), representing 2.2%; the herbicide glyphosate and the wood preservative pentachlorophenol, each representing 1.4%; and the anti-sapstain sodium carbonate, representing 1.1% of the pesticide total.

The long-term objective of these pesticide surveys is to determine trends in pesticide sales and use. The 1995 survey provides the first opportunity to compare pesticide sales and use with the 1991 data. Although a limited comparison was made, the analysis should be viewed with caution as two data points are insufficient to suggest a trend. Furthermore, pesticide use can vary significantly from year to year in the absence of any overall changes in use patterns. A more meaningful comparison was possible for Anti-sapstain data, because Environment Canada was able to provide data for 1993, 1994 and 1995 in addition to the 1991 data.

The following are the major findings of the 1991 and 1995 data comparisons:

- Of the active ingredients that are not wood treatments or slimicides, five active ingredients were among the top six sold in both 1991 and 1995. These were insecticidal mineral oil, glyphosate, mancozeb, captan and sulphur.
- The total sales of pesticides classified as Restricted were lower in 1995 than in 1991. The sales of some Restricted pesticide active ingredients decreased substantially while others increased.
- The use of wood preservatives increased in 1995 compared with 1991, primarily as a result of an increase in creosote use. The operator of one plant, which showed a three-fold increase in creosote use in 1995 from 1991, stated that a five-fold change from year to year is not unusual.
- The change in sales of flea control products was a relatively small decrease, all of which is potentially due to one vendor who reported Exempted pesticides in 1991 but not in 1995.
- The top six active ingredients used by landscape gardening services in the Lower Mainland in both years were insecticidal mineral oil, sodium metaborate tetrahydrate, 2,4-D amine salts, mecoprop (amine salts), glyphosate and sodium chlorate.
- Comparisons of the four years of anti-sapstain data show that the total amount of anti-sapstain chemicals used in 1995 was substantially lower than the amounts used in 1991, 1993 and 1994.

Further interpretation of the changes in sales or use of specific pesticide active ingredients may be possible, if there is information on changes in use or registration status. Seeking such information was beyond the scope of the current study.

Section 1: Introduction

1.1 Background

In 1991, the British Columbia Ministry of Environment, Lands and Parks (MELP) established the objective of encouraging and promoting adoption of Integrated Pest Management (IPM). IPM methods

reduce reliance on pesticides and eliminate unnecessary pesticide uses. By promoting IPM, MOE anticipated a 25% reduction in pesticide use province wide by the year 2001.

In 1992, MOE commissioned the first survey of pesticide sales and use records in British Columbia, using data from 1991. The survey was conducted by Norecol Environmental Consultants Ltd. (Norecol 1993). MOE's intention was that similar surveys would be conducted periodically to document changes in pesticide use. In 1996, Norecol, Dames & Moore, Inc. (NDM) was commissioned to undertake a survey of 1995 pesticide data and to compare the results with the 1991 study.

The 1991 survey included the following data sources:

- pesticide sales and use information filed as part of the licence application requirements for retail pesticide vendors and licensed pest control services;
- a survey of wholesalers of Domestic-label pesticides, whose sales are exempted from the reporting requirements;
- a survey of wood preservative plants;
- a survey of sales of anti-sapstain chemicals; and
- a survey of sales of slimicides (biocides used in cooling towers and paper making).

The 1995 study was somewhat more limited in scope than the survey of 1991, as only pest control services located in the Lower Mainland and licensed in the landscaping category were included in the 1995 survey. In the 1991 survey pest control services from all MOE regions were included. As well, a broader range of Domestic label pesticides were analyzed in the 1991 survey than in the 1995 study, which only analyzed the Domestic pesticides sold by veterinarians. Slimicides, which were included in the 1991 survey, were also absent from the 1995 survey. With the exception of these omissions, the 1995 survey provided the first opportunity to monitor changes in pesticide use patterns.

1.2 Study Objectives

The major objectives of the 1995 survey were to:

- obtain pesticide sales records for 1995, including domestic, veterinary and commercial pesticides;
- obtain pesticide use data for 1995 for anti-sapstain chemicals and wood preservatives;

- obtain pesticide use records for the Lower Mainland Region from annual summaries of use submitted by pest control services renewing licenses in the landscape use category; and
- compile the information into databases and summary tables so that the data could be compared to the results from the 1991 survey.

Comparison of 1991 & 1995 Pesticide Survey Components

1991	1995
Reportable Pesticide Sales	Reportable Pesticide Sales
Domestic Pesticide Sales	Domestic Pesticide Sales
Wood Preservatives	(Data incomplete)
Anti-sapstain Chemicals	Wood Preservatives
Slimicides	Anti-sapstain Chemicals
Pesticide Applications by Licensed Services	Pesticide Applications by Licensed Services
(All categories, all regions)	(Landscaping category, Lower Mainland only)

This report presents detailed information on pesticide sales and use for British Columbia as a whole and for eight geographical regions. It discusses the data quality and includes a limited comparison between the 1991 and 1995 data sets.

Section 2: Survey Methods

2.1 Approach

The characterization of 1995 pesticide use in British Columbia involved data gathering and data analysis. This chapter describes the tasks associated with data gathering and the evaluation of data quality.

The study included two primary types of data gathering:

- acquisition and compilation of information from existing data sources; and
- acquisition of new data through vendor or user surveys.

The existing data sources used were the Annual Summary of Reportable Pesticide Sales by licensed vendors and the Annual Summary of Pesticide Use by pest control services licensees. In addition, data for anti-sapstain use were obtained from the 1995 annual survey conducted by Environment Canada. Data obtained in whole or in part from surveys of pesticide vendors included sales of domestic pesticides (including flea control products sold by veterinarians). Data obtained in whole or in part from surveys of pesticide users included heavy-duty wood preservatives. The following sections describe the methods of acquiring and compiling data from these sources.

2.2 Reportable Pesticide Sales Summaries and Summaries of Use By Lower Mainland Landscaping Service Licensees

2.2.1 Background

Each year, a pesticide vendor is required to file a summary of pesticide sales over the past year in order to renew a licence. The annual summary lists all "Reportable" pesticides, that is products having a Restricted or Commercial use label. The vendor reports the product name and formulation, quantity of pesticide sold and the federal Pesticide Control Products Act registration number (PCP number). This reporting is intended to apply only to products sold to end users (not for resale).

In order to keep track of pesticide sales, the vendor is expected to maintain a register that records the product, amount sold, and purchaser for each Reportable pesticide sale. The vendor may compile the Annual Summary from the purchase register or from business records. The purchase register does not have to be submitted with the licence application, but it must be available for review by MOE staff upon request.

Similarly, holders of pest control service licences must report summaries of their pesticide use annually when they apply for licence renewal. They also must keep daily use records, which include information on the purpose for which the pesticide was applied.

Pest control service licensees may apply pesticides in one or more designated categories. The licence categories include agriculture, aquatic weed control, forestry, forest nurseries and seed orchards, predator control (restricted to MOE staff), industrial vegetation control, industrial vegetation-pavers, landscape, mosquito and biting fly control, noxious weed control, product fumigation, structural, and structural-wood preservation. These categories provide information on the purposes for which the pesticides were applied.

The 1995 survey included obtaining and summarizing the annual reports for all pesticide vendors plus pest control services licensees in the landscape category from the Lower Mainland only.

2.2.2 Data Acquisition and Database Entry

MOE regional offices provided annual sales summaries from 193 vendors; reports indicating nil sales of Reportable pesticides were excluded. The Lower Mainland regional office also provided annual use summaries from 232 landscape pest control service licensees. NDM entered all data from the summary forms into two computer databases (one for vendors and one for services licensees). The information recorded included the region, vendor or user identification (licence number, name, city and postal code), product name and formulation, PCP number and quantity sold. Sales by several vendors in Dawson Creek (Region 7) were reduced by 50% based on the licensees' statements that approximately half their sales were to residents of Alberta.

Sixteen pest control services were licensed in more than one category. In order to limit the survey to landscape use only, NDM telephoned all multiple-category licensees and requested that they indicate the amounts of pesticides applied for landscaping only. All companies provided either exact quantities or estimates of quantities used for landscaping, except for one licensee, who was unable to estimate the amount of a herbicide applied for landscaping only. This herbicide was only one of the 13 pesticides that the company had applied. Quantities in the database were adjusted based on the licensees' information.

2.2.3 Data Analysis and Presentation

The Pest Management Regulatory Agency of Health Canada (PMRA) provided a computer database (the "PCP database") of active ingredients and percent guarantees for all pesticides currently registered or that have been registered within the past five years and may still legally be sold. This

database also included information on whether the product was for restricted, commercial, domestic, manufacturing or technical use. PMRA also provided lists of active ingredients and percent guarantees for pesticide/fertilizer combinations that are registered under the Fertilizer Act.

The PCP database was used to search for the PCP numbers contained in the vendor and service licensee databases. The PCP number was used to identify the pesticide active ingredient and 'percent guarantee', which is the formulated product concentration. The active ingredient(s), percent guarantee and licensed use of each pesticide were copied from the PMRA database into the vendor and service licensee databases. The percent guarantees were then used to calculate the quantities of active ingredients sold by vendors and used by service licensees. Active ingredients and percent guarantees for pesticide/fertilizer combinations were entered manually into the sales and use databases.

In approximately 16% of the individual pesticide records, the recorder either failed to report a PCP number or reported a number that was clearly wrong. For example, a product described as diazinon was reported with the PCP number for Roundup (glyphosate), or the PCP number reported was a technical or manufacturing product. NDM screened the database for these instances and identified the probable PCP number based on the product name and formulation.

In some instances where the recorder provided no formulation data (e.g., simply listed as diazinon), the product could have had several possible formulations. These records were assigned a formulation (active ingredient and percent guarantee) based on proportional representation of the different formulations of that active ingredient in the database. For example, if approximately 80% of the reported Basudin was formulation 50W and 20% was formulation 5G, then 80% of the products reported as Basudin but lacking a valid PCP number were assigned the formulation for Basudin 50W. The remaining 20% were assigned the formulation for Basudin 5G. Where only single records existed, the record was assigned the formulation that predominated in the region that the particular record represented.

Some products were reported with PCP numbers that did not appear in the PMRA database. Not all of these records involved incorrect PCP numbers. Rather, some were from products that are not currently registered, but that had been registered at some time in the past. NDM contacted MOE and PMRA staff to identify the formulations of products not currently registered and added this information to the sales and use databases. The outdated PCP numbers so identified included several products that were also identified as outdated registrations during the 1991 survey.

Sales and use data for most formulated products as reported by the vendors or service licensees were converted to kilograms of active ingredient(s) by multiplying the volume sold by the percent guarantee. For example, 1 kg of a 25% concentrate product equals 0.25 kg of active ingredient. Since the method of reporting the percent guarantee varies to some extent among products, different approaches were used as follows:

- If the guarantee was reported as a percent for solid products (those sold in kilogram or milligram sizes) or in grams per litre (g/L) for liquid products (those sold in litre or millilitre sizes), the number of kilograms of active ingredient was calculated directly using the appropriate multiplication.
- Some products sold as liquids have the guarantee given as percent (e.g.,, Sevin XLR insecticide, Starbar Dairy Spray and similar fly control products, Clean Crop Diazinon 500). For these products one litre was assumed to equal one kilogram. This method is the standard recommended by MOE for reporting pesticide use under permit requirements.
- A few products have the percent guarantee reported in non-standard units. The most important of these products is the biological pesticide Bacillus thuringiensis (BT), which is measured in bioactive units (btu or itu) per litre or per kilogram. For pesticide permit reporting, MOE suggests that BT be reported as total litres or kilograms of product applied, without calculation of the active agent. The present study used this approach, which was also used for the 1991 survey (Norecol 1993).
- The other major products for which the percent guarantee is reported in non-standard units are fumigants. For products such as Plant-Fume, the guarantee is reported as grams or percent in smoke. The quantity of these products sold was also considered equivalent to the active ingredient.

Following calculation of the quantities of active ingredients, the data were summarized and tabulated in the following manner:

- reportable pesticide sales data were totalled to provide quantities of each active ingredient sold in each of the eight geographical regions and the total quantity sold in the province; and
- the pesticide control service data (landscape use data) were totalled to provide quantities of each active ingredient applied and the total quantity used in the Lower Mainland region.

2.3 Domestic Pesticide Vendors survey

2.3.1 Identification of Wholesale Vendors

Vendors of Domestic label pesticides are not required to report their sales on an annual summary form. For the 1991 pesticide use survey Norecol (1993) surveyed wholesale distributors of flea control products distributed through veterinarians and wholesale distributors of Domestic label pesticides. The wholesale distributors were identified through an initial survey of 110 retail distributors from across the province and 10 Lower Mainland veterinary clinics.

To determine whether there had been significant changes in the wholesale distributors since 1991, NDM conducted a more limited survey of 26 retail outlets as well as the British Columbia Veterinary Association. Retail vendors were selected for the survey based on their size and location (region). The selection was non-random to the extent of ensuring that at least one affiliate of each interprovincial chain that had not been contacted for the 1991 survey was represented.

Each retailer selected received a letter explaining the purpose of the survey, a questionnaire and a leaflet summarizing the 1991 survey results. The retailer was asked to identify all sources of domestic pesticides, such as local wholesale distributors, manufacturing representative, head office, etc. Letters were followed by telephone contacts.

Based on the retail vendor responses, NDM sent letters to 14 suppliers, who included 4 wholesale distributors of Domestic label pesticides, 6 chain store head offices, and 3 veterinary product suppliers. The letters explained the purpose of the survey, indicated the information required (pesticide name, formulation, PCP number, and quantity sold by region of the province), and requested cooperation. The leaflet summarizing the 1991 survey results was also included. Letters were followed up with telephone calls. MOE staff sent additional letters to 6 distributors of Domestic products and one distributor of veterinary products after they failed to respond to the initial requests for data.

2.3.2 Data Acquisition and Database Entry

Data were received from three wholesale distributors of Domestic label pesticides and two veterinary product suppliers. The data were entered into a database similar to that described for the Reportable pesticides sales information. Because a breakdown of pesticide sales by provincial region was not available from the suppliers, only total sales data were entered.

2.3.3 Data Analysis and Presentation

Due to the poor response by the wholesale suppliers of pesticides for home and garden use, the complete Domestic survey data were not analyzed. However, all of the wholesale suppliers of pesticides sold by veterinarians responded to the survey. Therefore, total quantities of pesticide active ingredients sold by veterinarians in British Columbia were calculated.

2.4 Wood Preservative Plant Survey

Data on use of heavy duty wood preservatives were obtained by surveying 16 of 17 wood preservative plants in the province. A list of wood preservative plants was obtained from Environment Canada. The plant managers were contacted by letter and telephone to request cooperation. Each received a survey form asking them to list all wood preservative chemicals used, with their PCP numbers and amounts used during 1995. Non-responses were followed up with phone calls.

All of the 16 companies contacted provided use data. The 17th company could not be contacted and apparently is no longer in business.

Data obtained were entered into a database with a structure similar to that described in Section 2.2. Data were summarized by chemical and by region.

2.5 Anti-sapstain Use Data

Environment Canada (S. Liu, pers. comm.) provided data tables from its annual survey of anti-sapstain use. The tables provided total usage in British Columbia by product and by active ingredient. No regional breakdown of data was available.

2.6 Quality Assurance / Quality Control

The survey methods included procedures to ensure a high degree of data accuracy (quality assurance) and protocols to evaluate data quality (quality control). Quality assurance procedures included:

- checking to ensure that reports from large volume vendors were received;
- where possible, identifying errors or irregularities before data were entered into the databases (e.g., missing PCP numbers, missing quantities or quantities reported in non-standard units such as "cases" or "pieces");

- checking printouts of databases for data entry errors;
- sorting the data by PCP number and checking to see that product names and PCP numbers corresponded;
- checking again for correspondence between PCP number and product name after linking with the database of PCP numbers (Section 2.2.3);
- screening calculated quantities of active ingredients for outliers, with follow up to determine whether outliers reflect data entry or reporting errors; and
- rechecking entries and reported quantities for all active ingredients whose total quantities were substantially higher than those found during the 1991 survey.

The vendors expected to account for large volume sales in each region were identified in two ways. First, the Crop Protection Institute has implemented a program of certifying "Phase III" warehouses, which are approved to handle Commercial and Restricted pesticides. Vendors having Phase III warehouse certification are expected to account for the majority of Reportable pesticide sales in British Columbia. In addition, vendors who had sold at least 10 Reportable pesticides in 1991 and were still licensed in 1996 were considered potential large volume vendors.

NDM checked the reports received to ensure that all potential large volume vendors had reported. When missing reports were identified, the MOE regional office followed up and supplied the missing forms.

Significant errors or potential errors were followed up with phone calls to the vendors or service licensees. Missing quantities, units not quantifiable in kilograms or litres (e.g., "cases") and unusually large quantities were considered significant and were followed up. Missing or incorrect PCP numbers were not considered significant unless a particular vendor had a large number of such numbers, and the correct numbers could not be readily identified from the product names. Database entries were corrected based on information supplied by the vendor or licensee.

Data quality was evaluated by keeping a record of all errors identified. The errors were divided into categories (e.g., missing/incorrect PCP number, quantity error). These records were kept separately for sales and service licence reports. The total number of errors in each category was calculated and expressed as a percentage of the total data entries. The percentages of vendors and service licensees who had made errors were also calculated.

In addition, NDM contacted 10% of the vendors and landscape services by telephone to discuss their methods of calculating the quantities provided on the reporting forms. The service licensees were

selected at random. Vendors were selected by a stratified, semi-random method. The stratification was by region, in proportion to the total volume of sales in each region. The selection method was semi-random because only the vendors who had sold at least 0.5% to 1.0% of the total active ingredients in a region were selected. This was done because the accuracy of data reported by large volume vendors has a greater effect on overall data quality than the accuracy of data reported by small vendors.

The vendors / licensees were asked the following questions:

- Did you calculate your annual sales / use from computerized records?
- Did you calculate your annual sales / use from the Reportable Sales Register or Daily Use Record? If so, how do you ensure that this record is accurate?
- Did you calculate your annual sales / use by subtracting stock on hand from annual purchases?
- Do you use some other method of calculating annual sales? If so, please describe.

The numbers of vendors or licensees using a particular calculation method were tabulated separately. The methods were ranked with respect to probable accuracy. For examples, computerized sales records were assumed to be most accurate; accuracy of other methods were judged by the interviewer based on responses to follow-up questions.

Section 3: Data Quality

3.1 Reportable Pesticide Sales Summaries and Summaries of Use by Lower Mainland Landscaping Service Licensees

3.1.1 Errors and Irregularities on Sales Reports

The following types of errors and irregularities were identified on the annual summaries of reportable pesticide sales:

- missing or incorrect PCP numbers. Incorrect numbers include those that corresponded to different active ingredients and/or formulations than those listed on the report and numbers that were not recorded in the current or historical PMRA database;
- more than one PCP number reported for the same product (i.e., two or more products with identical or similar formulations were combined);
- quantity errors or irregularities (non-standard units, missing units, missing quantities);

- unclear reporting of pesticides sold by "concept packaging" in which two or more components of a tank mix, such as an herbicide and an adjuvant or two herbicides, are sold in a single package, often with only one component of the package reported;
- other errors (such as failure to include the vendor's name on the report form).

Of the 193 Reportable Sales Summaries received, 40% contained at least one error. The majority of these errors involved missing or incorrect PCP numbers. Several vendors filed reports that contained no PCP numbers. Over 13% of the total data entries (lines on the reporting forms) contained PCP number errors. In addition, 20% of the reports contained quantity errors or irregularities, while an additional 7% contained errors related to the 'concept' packaging of two or more products. The quantity errors, including errors related to this type of packaging, involved only 5% of the total data entries. None of the outliers identified during data screening were due to reporting errors by the vendors.

3.1.2 Errors and Irregularities on Use Reports

The following types of errors and irregularities were identified on the annual summaries of pesticide use by service licensees:

- missing or incorrect PCP numbers. Missing registration numbers for fertilizer-pesticide combinations were also common but were not included in the error summary as fertilizers do not have actual PCP numbers;
- unit irregularities (e.g., reporting of quantities in "tablespoons" was relatively common);
- missing quantities, approximate quantities due to the inability to separate landscape use from other uses, and quantities reported as applied (i.e., diluted); and
- other (e.g., quantities of two similar products combined).

Of the 232 Service Licence Use Summaries, 44% contained at least one error. As observed for the sales reports, the majority of errors involved missing or incorrect PCP numbers. Just under 13% of the total data entries contained PCP number errors. The number of errors in this category would have been higher had missing registration numbers for fertilizer-pesticide combinations been considered errors. Only 3% of the reports and fewer than 2% of the total data entries contained erroneous quantities.

3.1.3 Methods of Calculating Pesticide Sales or Use

How vendors calculated their reportable pesticide sales was determined for 39 vendors. These represented 20% of the vendors in British Columbia and accounted for 68% of the total active ingredients sold in 1995.

The majority of the vendors used some type of computerized record to calculate pesticide sales. Of the 39 vendors surveyed, 22 (56%) used computerized records, 14 (36%) used the Reportable Sales Register, 2 (5%) used inventory records and 1 (3%) cross-checked computerized records with the reportable register. The large-volume vendors generally used computerized records. Thus, 88% of the total sales volume represented by the survey (at least 60% of the total sales in the province) were calculated from computerized records. In contrast, only 8% of the total sales volume represented by the survey (or 8% of the total sales in the province) were calculated from Reportable Sales Registers. Assuming that a computerized record is the most accurate method of calculating pesticide sales, the overall accuracy of the survey data should be high. For data transferred to the Reportable Sales Summary forms, however, transcription errors and, in some cases, calculation errors are possible. For example, some of the computerized records submitted had the data recorded as units sold (e.g., 124 units of a 500 mL bottle). Vendors who used the Reportable Sales Summary forms in combination with these types of records would have had to calculate total quantities manually, increasing the possibility of errors. Such errors (if any) were not apparent on the reporting forms. Twenty service licensees (9% of the landscape licensees in the Lower Mainland) responded to the survey. Of these, 16 (80%) used the Daily Use Record to calculate total pesticide use for the year; two of these respondents claimed to have highly accurate records. Only one licensee (5% of those surveyed) used an inventory method of calculating use. The remaining three licensees (15%) replied that the values reported were estimated either from the daily record or from a combination of inventory and the Daily Use Record. In addition, two of the respondents indicated that they had reported diluted pesticide quantities (e.g., 10 L applied actually contained only 0.06 L of the pesticide product). The accuracy of the landscape service data depends upon the accuracy with which the companies maintained their Daily Use Records. It appears from responses to the survey that the level of accuracy may vary considerably from one licensee to another. Overall, the service licensee use records are likely to be less accurate than the sales records due to this variability.

3.2 Other Survey Components

There is little or no basis with which to estimate the data accuracy of the other survey components. Environment Canada did not provide any estimate of the anti-sapstain data accuracy. There was no attempt to determine how the wood treatment plant operators or veterinary pesticide wholesalers calculated the quantities they reported. The only inaccuracies apparent on their reports involved PCP numbers.

Some inaccuracy is likely in the wood preservative survey data, as most of the treatment plant operators did not know the PCP numbers of the products they used. Lack of a PCP number potentially affects chromated copper arsenate (CCA), which is available in several formulations. In both the current survey and the 1991 survey, respondents reported using either 50% or 60% formulations. The majority, who gave either a valid PCP number or the formulation, used the 50% formulation. Thus, where both the PCP number and formulation were missing, the 50% formulation was assumed. The veterinary product wholesalers accurately reported PCP numbers. There were some inconsistencies, however, in the types of products reported by the different vendors of veterinary products. The vendor who received a follow-up letter from MOE did not report products that are Exempted under the British Columbia Pesticide Control Act Regulation. Thus, this vendor reported only flea control products for use on premises, and did not report products for use on pets (e.g., dog and cat flea sprays and shampoos) or disinfectants. The other two vendors reported products for use on pets; one also reported disinfectants.

Section 4: Survey Results

4.1 Overall Pesticide Sales and Use

The study results showed that in 1995, British Columbians purchased or used 8,674,920 kg of pesticide active ingredients. This excludes most Domestic label products, but does include Domestic products sold by veterinarians. Of this total, 7,687,656 kg (88.6%) were anti-microbial chemicals, consisting primarily of commercially applied wood preservatives and anti-sapstain chemicals (Figure 4-1, Table 4-1). Insecticides accounted for 354,212 kg (4.1%) of the total pesticides, while 327,722 kg (3.8%) were herbicides and 232,490 kg (2.7%) were fungicides. The remaining pesticides included fumigants, plant growth regulators, vertebrate control products, adjuvants and surfactants.

The total, province wide pesticide use included 254 active ingredients (Appendix A). Twenty of these active ingredients accounted for 95.5% of the pesticides sold or used during 1995 (Table 4-2). Creosote alone accounted for 67.7% of the pesticide use in the province. The wood preservatives chromated copper arsenate (CCA) and didecyl dimethyl ammonium chloride (DDAC) accounted for 10.5% and 5.3% of all pesticides used, respectively. Other important active ingredients included: insecticidal mineral oil, representing 2.4%; borax (includes all forms of borate and borax, which are primarily used as anti-sapstains, except sodium metaborate tetrahydrate), representing 2.2%; the herbicide glyphosate and the wood preservative pentachlorophenol, each representing 1.4%; and the anti-sapstain sodium carbonate, representing 1.1% of pesticides used.

4.2 Reportable Pesticides Sold

In British Columbia, Reportable pesticides are all products that have a Restricted or Commercial use label. They include pesticides used for agriculture and industrial applications.

Reportable pesticides sold accounted for 11% of the total quantity of pesticide active ingredients included in the 1995 survey. Of these, twelve active ingredients accounted for 60% of the Reportable pesticides sold. These active ingredients were: insecticidal and herbicidal mineral oils; the herbicides glyphosate and sodium metaborate tetrahydrate; the fungicides mancozeb, captan, metriam, sulphur and lime sulphur; the insecticides diazinon and azinphos-methyl; and the wood fumigant metam (Figure 4-2).

4.3 Wood Preservatives

The majority of pesticides used in British Columbia in 1995 were applied for wood preservation. Wood preservative chemicals are intended to provide long-term protection against fungi, insects, or marine borers for wood that will be used in exposed situations (e.g., railway ties, patio decks). Wood preservation involves pressure or thermal impregnation of the preservative chemicals into the wood.

Table 4-3 presents the results of the wood preservative use survey. Only four types of wood preservatives were used in British Columbia in 1995. These products were creosote (which was applied alone or mixed in equal proportions with petroleum oil), chromated copper arsenate (CCA), pentachlorophenol, and ammoniacal copper arsenate (ACA). The majority of wood preservation facilities used only CCA. Three plants applied creosote, but the quantities applied were high enough to make creosote the most-used wood preservative in the province in terms of total kilograms (Figure 4-3). A single plant applied ACA, and this chemical accounted for only 0.01% of total wood preservative use.

4.4 Anti-sapstain Use

Anti-sapstain chemicals are used by lumber mills to prevent fungal growth on, and staining of, cut lumber. They are intended to offer relatively short term protection to lumber that will, when used in construction, be sealed, painted, stained, or otherwise protected from exposure to moisture and fungi.

Table 4-4 and Figure 4-4 presents the results of Environment Canada's anti-sapstain use survey. Only six anti-sapstain active ingredients were used. The major anti-sapstain active ingredients identified were DDAC, borax or borate, sodium carbonate (Na2CO3) and 3-iodo-2-propynyl butyl carbamate (IPBC). The active ingredients 2-(thiocyanomethylthio) benzothiazole (TCMTB) and azaconazole constituted a minor portion of the use.

4.5 Domestic Pesticides

Response to the Domestic pesticide survey was poor. Only two of the five British Columbia based wholesalers and two of the six out-of-province chain store head offices responded with data in time for their information to be included in the report. One of the two out-of-province vendors supplied data for 1996 rather than 1995, and the data were not in a usable format. One British Columbia-based wholesaler, who accounted for the majority of pesticide active ingredients sold in 1991, refused to participate in the 1995 survey. This vendor suggested that the market had changed since 1991, with mass marketing companies, who obtain pesticides from head offices outside British Columbia, taking an increasing market share. As NDM could not determine the proportion of the total pesticide sales represented by the survey respondents, the Domestic data were not presented or included in the total pesticide sales for British Columbia.

Data were received, however, from all three suppliers of pesticides sold to the public through veterinarians. Data for these products are included in the provincial totals. Based on wholesale volumes, veterinarians sold or used 1,000 kg of pesticide active ingredients in 1995. Pesticides supplied to veterinarians included: 622 kg of flea and tick control active ingredients for home use on dogs and cats; 144 kg of fly and ectoparasite control active ingredients for farm use on cattle and horses; and 234 kg of disinfectant active ingredients (Table 4-5). Two active ingredients, piperonyl butoxide and n-octyl bicycloheptene dicarboximide, accounted for 73% of the pesticides sold by veterinarians for home use in dog and cat flea control.

4.6 Regional Differences in Pesticide Sales

As the locations of all licensed pesticide vendors in British Columbia are known, the reportable pesticide sales data could be summarized by region. The complete summary is presented in Appendix C. The regional data must be viewed with some caution, however, as some vendors sell to purchasers in other regions. For example, when queried about the quantity of quintozene shown on his annual

report, a Lower Mainland (Region 2) vendor responded that a large percentage of the product was shipped to the interior of the province (likely Region 3).

The regional method of data tabulation showed some differences in pesticide sales that likely are related to regional differences in pesticide use. For example, insecticidal mineral oil was number one in sales in the Okanagan and Kootenay regions, respectively (Regions 3 and 4, Figure 1-1), where fruit trees are the major agricultural crops. It was also important in Vancouver Island and the Lower Mainland (Region 1 and 2), but it was not sold in the rest of the province. In contrast, the herbicides triallate and ethalfluralin were among the major products sold in the Peace River area (Region 7), where grains are the major crop. Sales of these herbicides in other areas of the province were negligible.

4.7 Pesticide Use by Lower Mainland Landscaping

Service Licensees

Unlike the 1991 survey, the 1995 survey did not attempt to identify the different purposes for which the pesticides were applied. The study did, however, include a survey of pest control services in the Lower Mainland (Region 2) that were licensed to apply pesticides for the purpose of landscaping. Quantities of all pesticides applied for landscaping are given in Appendix C. Landscape services in the Lower Mainland applied 100 different active ingredients, of which 10 accounted for 86% of the pesticides applied by (Figure 4-5). Insecticidal mineral oil alone accounted for 26% of the total pesticide applied. The herbicides sodium metaborate tetrahydrate and sodium chlorate were also important. The other major active ingredients used by landscape services included the herbicides 2,4-D amine salts, glyphosate, mecoprop and dichlobenil; the insecticides diazinon and insecticidal soaps; and the fungicide lime sulphur.

Section 5: Comparison of 1991 and 1995 Survey Results

5.1 Objectives and Limitations

The long-term objective of the pesticide surveys begun in 1991 is to determine trends in pesticide sales and use. The 1995 survey provides the first opportunity to compare such data. Interpretation of results must necessarily be limited, however, because two data points are not enough to suggest a trend. Furthermore, pesticide use can vary substantially from year to year in the absence of any

overall changes in use patterns. Factors that affect pesticide sales and use include: weather (e.g., wet weather promotes fungal growth, increasing the use of fungicides); outbreaks of particular insect pests; changes in crop prices, which may affect area of crops planted and therefore in the pesticides required; pesticide prices; and other economic factors, such as increases or decreases in highway construction, which may affect the amount of herbicides applied during paving.

Since the typical year-to-year variability in pesticide sales and use is as yet unknown, there is no way to gauge the significance of increases or decreases in sales or use of most active ingredients. The comparative data may be useful, however, where there is information regarding changes in the registration status or uses of specific active ingredients.

Due to these data limitations, the 1995 to 1991 comparisons are presented in tabular form without interpretation. The one exception is the anti-sapstain data, which were available from Environment Canada for 1993 and 1994, as well as 1995.

5.2 Data Analysis

Prior to preparation of the comparison tables, the 1991 survey database was reviewed, and some changes were made to ensure consistency with the 1995 data treatment. For example, in 1991 most reported sales of formaldehyde were not included in the total pesticide sales calculations as no valid PCP numbers were given. For the 1995 data, all formaldehyde was assumed to be a 37% formulation, and the data were included in the summaries. Therefore, the 1991 data were adjusted to include formaldehyde sales. The screening identified 12 other sales entries and 9 use entries that had not been included in the 1991 sales calculations due to missing PCP numbers, but that could be identified by the product name. These data were also included in the recalculated 1991 sales data and in the use totals for the landscaping sector in the Lower Mainland.

In addition, as the comparison tables were prepared, some errors were noted in the 1991 database. These errors included:

- a service licensee classified in the landscaping category that was (according to the name) a farm and had applied active ingredients that were common for agriculture but not used by any other landscaping services; and
- an error in converting imperial gallons to litres of creosote for one wood preservation plant.

These errors were corrected prior to comparing the 1991 and 1995 data. As a result of the changes, the amounts of some active ingredients used or applied in 1991 differ from the values given in the 1991 survey report (Norecol 1993).

5.3 1991 to 1995 Comparisons

The following 1991 to 1995 comparisons were determined to be the most useful:

- sales of all Reportable pesticide active ingredients (Appendix D);
- sales of the top 20 Reportable pesticides (Table 5-1);
- sales of pesticides federally labelled as Restricted (Table 5-2); this class of pesticides is the most strictly regulated in British Columbia, and changes in their sales are of particular interest;
- wood preservatives applied by wood treatment plants (Table 5-3); and
- flea control products sold by veterinarians, the only subset of Domestic pesticides for which comparable 1991 and 1995 data are available (Table 504).

All of these comparisons should be viewed with caution. As previously noted, year-to-year variability in pesticide sales or use may be high for reasons unrelated to changing use patterns.

Although there were changes in the total quantities sold, five active ingredients remained among the top six sold in both 1991 and 1995 (Table 5-1). These active ingredients were insecticidal mineral oil and glyphosate, which were numbers one and two respectively in both years, plus mancozeb, captan and sulphur.

There are explanations available for changes in a few of the top 20 pesticides. Sales of the fungicides chlorothalonil and quintozene were substantially higher in 1995 than in 1991. The vendors told NDM that in 1995, for the first time, chlorothalonil was registered for use on cranberries and quintozene was also being used on ginseng. Thus, changing use patterns affected the quantities of these active ingredients sold.

The total sales of Restricted pesticides were lower in 1995 than in 1991 (Table 5-2). The sales of some active ingredients decreased substantially, while others increased. The reasons for the changes are not known. Due to a change in the Pesticide Control Act Regulation, as of January 1, 1992, anyone purchasing a Restricted pesticide was required to have an applicator certificate. However, this does

not explain the greatest single decrease in sales of a Restricted pesticide, which was for methyl bromide, whose purchase required an applicator certificate before January 1, 1992.*

The use of wood preservatives increased in 1995 compared with 1991, primarily as a result of an increase in creosote use (Table 5-3). One plant alone used approximately three times as much creosote in 1995 as in 1991. The operator of this plant told us that a five-fold change from year to year was not unusual.

The change in sales of flea control products was relatively small (Table 5-4). All of the change is potentially due to one vendor who reported Exempted pesticides in 1991 but did not report these products in 1995.

The top six active ingredients used by landscape gardening services in the Lower Mainland remained relatively constant (Table 5-5). The top six active ingredients applied in both years were insecticidal mineral oil, sodium metaborate tetrahydrate, 2,4-D amine salts, mecoprop (amine salts), glyphosate and sodium chlorate.

At least one change in the pesticide active ingredients most used by landscaping services is due to an apparent reporting anomaly. Ferrous sulphide was included in the top 20 list in 1995, but its use was not reported in 1991. Ferrous sulphide is the active ingredient in lawn moss killers that are registered federally under the Fertilizer Act rather than under the Pest Control Products Act. Lawn moss killers were not included in any of the 1991 Pesticide Use Reports, although it is likely that this type of product would have been used.

Four years of data were available for anti-sapstain use (graphed in Figure 5-1aand Figure 5-1b). The total amount of anti-sapstain chemicals used in 1995 was substantially lower than the amounts used in 1991, 1993 and 1994 (more than three standard deviations below the mean of the previous three years' use). No explanation for this difference was found during NDM's survey. The graphs should be viewed with some caution, as even four data points are of limited value in defining a trend.

Further interpretation of the changes in sales or use of specific pesticide active ingredients may be possible, if there is information on changes in use or registration status. Seeking such information was beyond the scope of the current study.

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* Figures for 1995 methyl bromide use that became available from Environment Canada after this study was complete indicate that a considerably larger amount of methyl bromide was imported into BC than was recorded as sold in the survey. According to End of Year Summary Reports for MBr and annual summaries that companies are required to submit each year to Environment Canada, a total of 21,887.9 kg of methyl bromide was imported by a total of 13 companies. This includes 9333.6 kg for use on 7 farms, 2160.0 kg for one forest seedling company, 15.5 kg for one pest control company, and 10,378.8 kg for quarantine or pre-shipment use by 4 companies. Since the 1991 study was done, the major supplier of methyl bromide apparently transferred their sales and distribution to Ontario. Such pesticides, sold directly to users from outside of the province, are not captured by the MELP record system for pesticide vendors.

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Norecol Environmental Consultants. 1993. A Comprehensive Survey of Pesticide Use in

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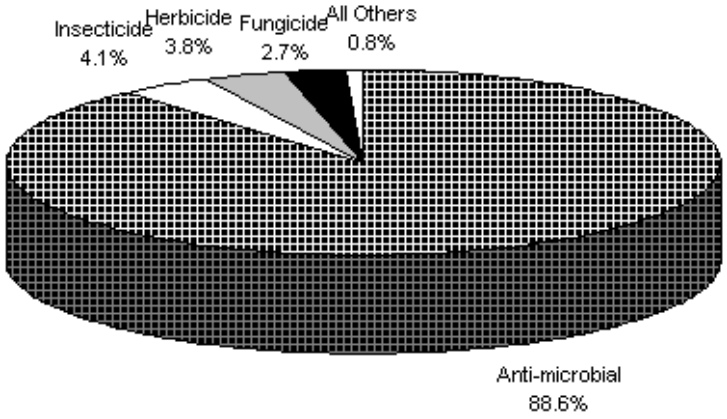


FIGURE 4-1
PERCENTAGES OF ACITIVE INGREDIENTS SOLD IN BRITISH COLUMBIA IN 1995
BY CHEMICAL CLASS

Survey of Pesticide Use in British Columbia: 1995

Table 4-1: Percentages of Active Ingredients (by Chemical Class) of Pesticides Sold or Used in British Columbia, 1995

CLASS	PERCENT
Anti-microbial	88.6%
Insecticide	4.1%
Herbicide	3.8%
Fungicide	2.7%
All Others	0.8%

Survey of Pesticide Use in British Columbia: 1995

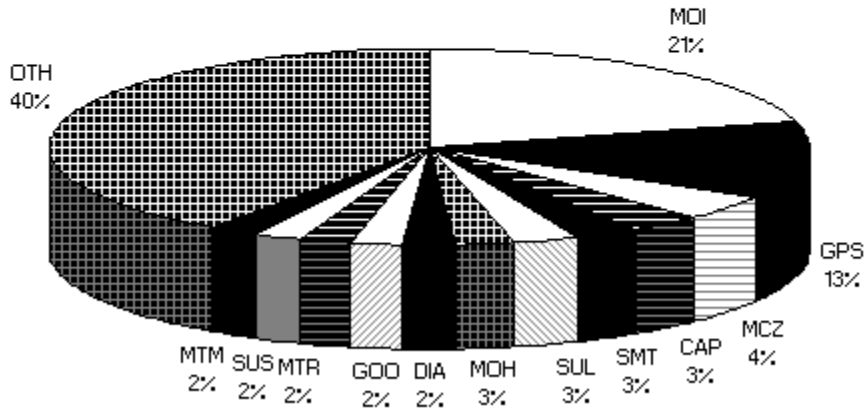
Table 4-2: Quantities of the Top Twenty Pesticides Sold or Used in British Columbia, 1995 (Excluding Domestic Pesticides*)

AI CODE	ACTIVE INGREDIENT	QUANTITY (kg)	% of TOTAL
CRT	Creosote	5,869,461	67.7%
	Chromated Copper Arsenate (CCA)	912,392	10.5%
QAK	Didecyl Dimethyl Ammonium Chloride (DDAC)	455,954	5.3%
MOI	Insecticidal Mineral Oil	206,440	2.4%
	Borax, all forms	187,823	2.2%
GPS	Glyphosate	124,698	1.4%
PCP	Pentachlorophenol	122,966	1.4%
SCB	Sodium Carbonate	94,225	1.1%
MCZ	Mancozeb	41,907	8.5%
IPB	IPBC	35,248	0.4%
CAP	Captan	29,160	0.3%
SMT	Sodium Metaborate Tetrahydrate	29,020	0.3%
SUL	Sulphur	26,363	0.3%
MOH	Herbicidal Mineral Oil	25,215	0.3%
DIA	Diazinon	22,552	0.3%
GOO	Azinphos-methyl	21,804	0.3%
MTR	Metiram	20,874	0.2%
SUS	Lime Sulphur	20,565	0.2%
MTM	Metam	20,422	0.2%
CUY	Copper Oxychloride	16,316	0.2%

	Percentage of Total		**95.5%**

*Domestic-label pesticides sold by veterinarians are included

FIGURE 4-2
PERCENTAGES OF REPORTABLE PESTICIDE ACTIVE INGREDIENTS SOLD IN BRITISH COLUMBIA IN 1995



Survey of Pesticide Use in British Columbia: 1995

Table 4-3: Quantities of Wood Preservative Active Ingredients Used in Wood Treatment Plants in British Columbia, 1995

	REGION					
PRODUCT	**2**	**3**	**4**	**5**	**6**	**TOTAL (kg)**
Creosote	2,430,998	3,245,381	0	193,082	0	5,869,461

OCA	395,132	56,709	128,795	108,424	223,333	912,392
Pentachlorophenol	29,541	0	74,180	19,246	0	122,966
ACA	909	0	0	0	0	909
GRAND TOTAL	**2,856,579**	**3,302,090**	**202,975**	**320,751**	**223,333**	**6,905,728**

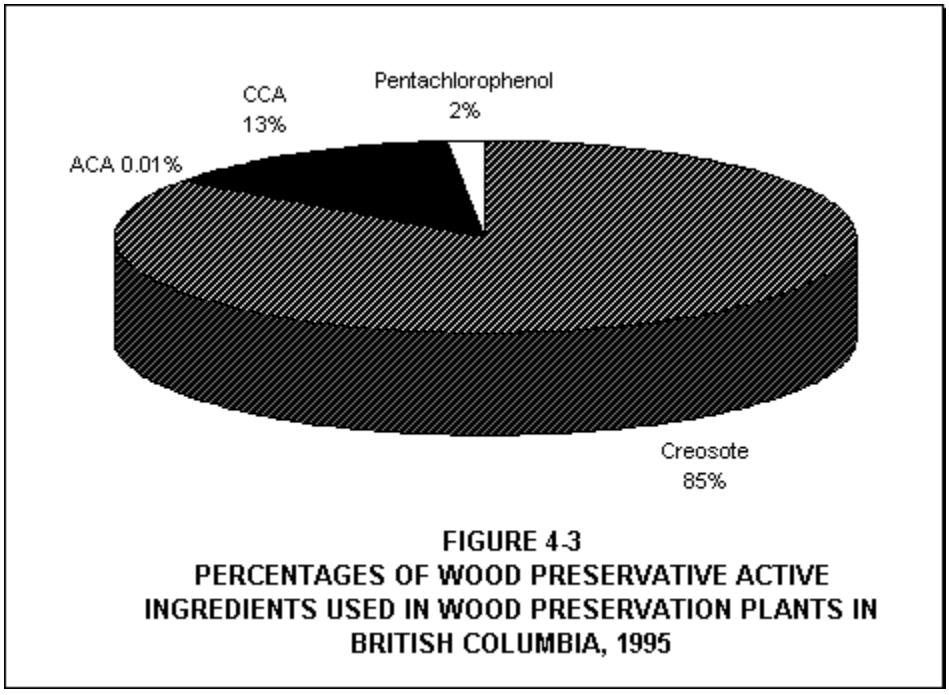


FIGURE 4-3
PERCENTAGES OF WOOD PRESERVATIVE ACTIVE INGREDIENTS USED IN WOOD PRESERVATION PLANTS IN BRITISH COLUMBIA, 1995

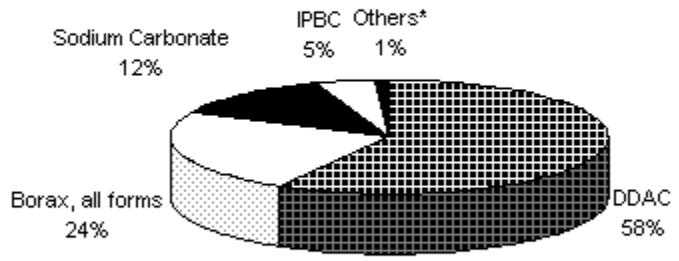
Survey of Pesticide Use in British Columbia: 1995

Table 4-4: Quantities of Anti-sapstain Active Ingredients Used in British Columbia in 1995

ACTIVE INGREDIENT	ABBREVIATED NAME	QUANTITY (kg)
Didecyl Dimethyl Ammonium Chloride	DDAC	455,947
Borax, all forms*	—	187,133

Sodium Carbonate	Na2C03	94,225
3-Iodo-2-Propynl Butyl Carbamate	IPBC	35,248
Azaconazole	—	5,778
2-(Thiocyanomethylthio) Benzothiazole	TCMTB	2,858
TOTAL ANTI-SAPSTAINS USED		**781,189**

FIGURE 4-4
PERCENTAGES OF ANTI-SAPSTAIN ACTIVE INGREDIENTS USED IN BRITISH COLUMBIA, 1995



* Others: Azaconazole 0.7%, TCMTB 0.4%

Survey of Pesticide Use in British Columbia: 1995

Table 4-5: Total Pesticide Active Ingredients (kg) Sold by Veterinarians in British Columbia in 1995

AI CODE	ACTIVE INGREDIENT	INTENDED USE*			
		FARM	HOME	OTHER*	TOTAL
PBU	Piperonyl Butoxide	0.95	307	—	307
MGK	N-Octyl Bicycloheptene Dicarboximide				

TUC	2-(Hydroxymethyl)-2-Nitro-1,3-Propanediol	—	—	112	112
PFL	Permethrin	26.8	42.6	—	69.4
PYR	Pyrethrins	1.10	56.1	—	57.2
FET	Fenthion	53.8	—	—	53.8
QAC	N-Alkyl (40% C12, 50% C14, 10% C16) Dimethyl Benzyl Ammonium Chloride	—	—	48.4	48.4
SUL	Sulphur	44.3	—	—	44.3
MPR	Methoprene	—	34.8	—	34.8
DUB	Chlorpyrifos	—	—	17.7	17.7
QAO	N-Alkyl (67% C12, 25% C14, 7% C16, 1% C18) Dimethyl Benzyl Ammonium Chloride	—	—	17.7	17.7
OPP	O-Phenylphenol	—	—	15.7	15.7
BCP	O-Benzyl-P-Chlorophenol	—	—	13.4	13.4
FOR	Formaldehyde	—	—	13.0	13.0
COU	Coumaphos	11.7	—	—	11.7
QAK	Didecyl Dimethyl Ammonium Chloride	—	—	6.05	6.05
BAY	Propoxur	—	5.81	—	5.81
QAL	N-Alkyl (5% C12, 60% C14, 5% C16) Dimethyl Benzyl Ammonium Chloride	—	—	4.81	4.81
MGD	Di-N-Propyl Isocinchomeronate	3.42	1.13	—	4.55
TPP	P-Tert Amyl Phenol	—	—	3.11	3.11

CAB	Carbaryl	—	1.55	—	1.55
ROT	Rotenone	0.66	—	—	0.66
ALM	D-Trans Allethrin	—	0.26	—	0.26
TOTAL SOLD		**144**	**622**	**234**	**1,000**

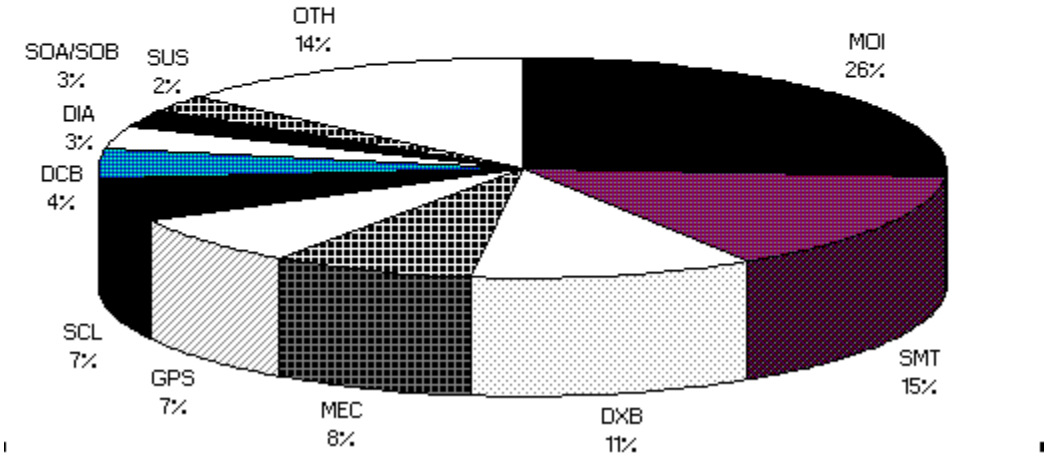
***Intended Uses:**

Farm - Fly control products and ectoparasite control products for cattle and horses

Home - Flea and tick control products for cats and dogs and their living quarters

Other - Primarily disinfectants

FIGURE 4-5
PESTICIDE ACTIVE INGREDIENTS USED BY LANDSCAPING SERVICES IN THE LOWER MAINLAND, BRITISH COLUMBIA, 1995



Survey of Pesticide Use in British Columbia: 1995

Table 5-1: Comparison of the Top 20 Reportable Pesticides Sold in British Columbia in 1991 and 1995

1991		1995	
RANK	**ACTIVE INGREDIENT**	**TOTAL (kg)**	**ACTIVE INGREDIENT**
1	Mineral Oil (Insecticidal or Adjuvant)	162,245	Mineral Oil (Insecticidal or Adjuvant)
2	Glyphosate	110,157	Glyphosate
3	Mineral Oil (Herbicidal or Plant Growth Regulator)	38,540	Mancozeb
4	Mancozeb	29,511	Captan
5	Captan	28,451	Sodium Metaborate Tetrahydrate
6	Sulphur	28,101	Sulphur
7	Metiram	27,618	Mineral Oil (Herbicidal or Plant Growth Regulator)
8	Metam	27,437	Diazinon
9	Ethalfluralin*	26,917	Azinphos-Methyl
10	Atrazine*	22,898	Metiram
11	Methyl Bromide*	21,958	Lime Sulphur or Calcium Polysulphide**
12	Triallate*	20,584	Metam
13	Diazinon	19,643	Copper Oxychloride
14	Azinphos-Methyl	17,820	Chlorothalonil**
15	Sodium Metaborate Tetrahydrate	14,259	Quintozene**
16	2,4-D Amine Salts	12,327	Formaldehyde**
17	Malathion*	12,094	Sodium Chlorate**
18	MCPA Amine Salts*	11,382	2,4-D Amine Salts

19	Metolachlor*	10,727	Bacillus Thuringiensis Berliner SSP Kurstaki**
20	Copper Oxychloride	10,202	Bacillus Thuringiensis, Serotype H-14**

* In top 20 list of reportable pesticides in 1991, but not 1995

** In top 20 list of reportable pesticides in 1995, but not 1991

Survey of Pesticide Use in British Columbia: 1995

Table 5-2: Comparison of Sales of Restricted Pesticides in British Columbia in 1991 and 1995

AI CODE	ACTIVE INGREDIENT	1991	1995	CHANGE FROM 1991 (kg)
		TOTAL SALES (kg)	TOTAL SALES (kg)	
AMP	4-Aminopyridine	0.07	0.21	+ 0.14
ALP	Aluminum Phosphide	200	736	+ 535
AMZ	Amitraz	—	69/3	+ 69.3
GOO	Azinphos-Methyl	17,820	21,804	+ 3,984
BTH	Bacillus Thuringiensis, Serotype H-14	3,188	11,270	+ 8,082
BDC	Bendiocarb	346	216	- 130
CAF	Carbofuran	1,021	997	- 23.5
CUT	Copper Triethanolamine Complex	276	96.5	- 179
DNB	Dinoseb	7,233	6.0	- 7,227
DIS	Disulfoton	702	556	- 146

FEL	Fensulfothion	211	—	- 211
FOM	Formetanate Hydrochloride	14.7	59.3	+ 44.6
MOM	Methamidophos	2,947	1,910	- 1,037
MBR	Methyl Bromide	21,958	3,805	- 18,153
CAS	Oleoresin Capsicum	—	0.73	+ 0.73
OXB	Oxamyl	141	2,027	+ 1,886
OXR	Oxyfluorfen	184	234	+ 49.8
PTH	Parathion	4,054	4,125	+ 70.3
PHR	Phorate	878	—	- 878
PPF	Propetamphos	16.3	7.6	- 8.69
PYF	Pyrazophos	12.0	9.0	- 3.0
STR	Strychnine	61.1	49.2	- 12.0
SFT	Sulfotep	2,131	3,665	+ 1,534
COY	Terbufos	143	585	+ 443
TQB	Triadimefon	13.5	—	- 13.5
WAT	Water Soluble Dyes	149	48.6	- 100
TOTAL RESTRICTED PESTICIDES SOLD		**65,794**	**56,455**	**- 9,338**

Includes only active ingredients for which at least 90% of sales were as Restricted products

Survey of Pesticide Use in British Columbia: 1995

Table 5-3: Comparison of Wood Preservative Active Ingredients Used by Wood Treatment Plants in 1991 and 1995

PRODUCT	1991 USE (kg)	1995 USE (kg)	CHANGE FROM 1991 (kg)
ACA	500	909	+ 409
CCA	651,134	912,392	+ 261,258
Creosote	2,245,711	5,869,461	+ 3,623,751
Pentachlorophenol	789,110	122,966	- 666,144
TOTAL USED	**3,686,455**	**6,905,728**	**+ 3,219,27**

Survey of Pesticide Use in British Columbia: 1995

Table 5-4: Comparison of Flea Control Products Sold by Veterinarians in British Columbia in 1991 and 1995

AI CODE	ACTIVE INGREDIENT	1991 SALES (kg)	1995 SALES (kg)	CHANGE FROM 1991 (kg)
CAB	Carbaryl	19.0	1.55	- 17.4
DUB	Chlorpyrifos	121	23.3	- 98.0
ALM	D-Trans Allethrin	0.18	0.26	+ 0.08
MGD	Di-N-Propyl Isocinchomeronate	—	1.13	- 1.13
MPR	Methoprene	40.0	34.8	- 5.18
MGK	N-Octyl Bicycloheptene Dicarboximide	255	150	- 105
PFL	Permethrin	1.63	42.6	+ 41.0
PBU	Piperonyl Butoxide	210	307	+ 96.5

BAY	Propoxur	—	5.81	+ 5.81
PYR	Pyrethrins	70.2	56.1	- 14.0
TOTAL SALES		**718**	**622**	**- 95.6**

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Table 5-5: Comparison of the Top 20 Pesticide Active Ingredients Applied by Landscaping Services in the Lower Mainland Region in 1991 and 1995

	1991		1995	
RANK	**ACTIVE INGREDIENT**	**TOTAL USED (kg)**	**ACTIVE INGREDIENT**	**TOTAL USED (kg)**
1	Sodium Metaborate Tetrahydrate	2,930	Mineral Oil (Insecticidal or Adjuvant)	4,183
2	Mineral Oil (Insecticidal or Adjuvant)	2,443	Sodium Metaborate Tetrahydrate	2,385
3	Glyphosate	2,163	2,4-D Amine Salts	1,714
4	Sodium Chlorate	1,321	Mecoprop, Amine Salts	1,235
5	2,4-D Amine Salts	1,135	Glyphosate	1,179
6	Mecoprop, Amine Salts	781	Sodium Chlorate	1,076
7	Diazinon	728	Dichlobenil	636
8	Paraquat	626	Diazinon	539
9	Mancozeb	559	Insecticidal Soaps	418
10	Quintozene	468	Lime Sulphur or Calcium	379

			Polysulphide	
11	Dichlobenil	394	Quintozene	371
12	Lime Sulphur or Calcium Polysulphide	328	Dicamba	263
13	Insecticidal Soaps	316	Mancozeb	157
14	Dicamba	160	Copper Oxychloride	146
15	Copper Oxychloride	132	Simazine**	93.6
16	Benomyl*	111	Bromacil**	84.4
17	Thiophanate-Methyl*	93.4	Ferrous Sulfate***	82.2
18	Amitrole*	91.1	Chlorothalonil**	72.1
19	Natural Gum Resins*	87.4	Methoxychlor**	67.3
20	MCPA Amine Salts	65.0	MCPA Amine Salts	62.1

* In top 20 list of pesticides in 1991, but not 1995

** In top 20 list of pesticides in 1995, but not 1991

*** Moss killer not included on 1995 reports